AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

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MASTER CAR BUILDERS' ASSOCIATIO .

Proceedings of the Thirtieth Annual Convention.

The thirtieth annual convention of the Master Car Builders' Association was called to order at Congress Hall, Saratogo, N. Y., June 17, 1896, at 9.30 a. m., President Lentz in the chair. After an opening prayer by a local pastor, Col. H. S. Haines made an interesting address, in which he dwelt at considerable length on the progress in car construction since the days when passenger cars were little better than the cabooses of to-day. He said that the master car builder of to-day must be an engineer, an architect and an artist in order to produce the magnificent, safe and comfortable passenger equipment of to-day. In freight-car construction the great reduction of dead weight in proportion to load, is to be credited to the master car builders and still further progress in this direction is desirable in both freight and passenger equipment. With the high speeds desired to-day, the capacity of the most powerful locomotives is taxed to haul the trains required and if the weights of cars could be so reduced as to enable a locomotive to haul six cars where five are now pulled, the gain would be a decided advantage.

He was followed by President Lentz, who made his annual address. In it he said that in the 12 months from June, 1895, to June, 1896, there had been 100 per cent. more cars built and contracted for than in the preceding 12 months. He congratulated the association on the fact that its standards had been better observed this year than at any time in the past. The code of rules reconstructed on the lines suggested by the Southern and Southwestern Railroad Club would be offered to the association for adoption. One striking suggestion he made was in relation to the decisions of the Arbitration Committee. Last year the committee passed on 330 cases, of which two roads were interested in 19. As these decisions involved much labor and expense he recommended that a road taking a case to the committee should remit with the papers and correspondence relating thereto a check for $10.00, which would be deposited in the treasury of the association.

The secretary's report showed a total membership last year of 372 and at the present time of 388. There are seven additional roads represented in the association, and the total cars represented at present number 1,209,291. The cash received by the secretary during tha year was $8,979. The treasurer's report shows a balance on hand June 11, 1895, of $4,916.22, and on June 16, 1896 ,of $5,509.91.

The dues for the year are fixed at $5.00, as heretofore.

The Auditing Committee was appointed as follows: E. W. Grieves, J. N. Barr, T. Fildes. They reported later that all accounts had been found correct.

Committees on resolutions, nominations and obituaries were also appointed.

Under the subject of new business, Mr. F. W. Lane was elected an associate member. It was decideded to hold two sessions of the convention per day. The formality of a roll call will be dispensed with at future conventions and members requested to turn in their names on cards to be provided by the secretary. The question of the proper loading of logs and rails on cars is so pressing that a committee was appointed to report at a late session of this convention, The committee consists of Messrs. Leeds, Bush, Lewis, Day, Stark, Haskell and Coller.

A resolution strongly endorsing the timber tests conducted by the Forestry Division of the U. S. Department of Agriculture was passed unanimously. The New York Central & Hudson River Railroad extended the courtesy of transportation to members, and the Delaware & Hudson Canal Company tendered an excursion to Lake George for Saturday to members and friends. These courtesies were duly acknowledged.

A letter was read from the Master Blacksmiths' Association, asking that members urge their Master Blacksmiths' Convention be held in Chicago in September. The communication was favorably received and members urged to act in accordance with its request.

Triple Valve Tests.

The reports of committees were next taken up. The first one called for was that on "Triple Valve Tests." The committee is a standing one, and it explained that it had received no valves for test during the year and therefore had no report to make.

Wheel and Track Gages.

The Committee on Standard Wheel and Track Gages, which was appointed to co-operate with a committee of the American Railway Association, reported that certain tests were in progress and that no report could be made at this session.

Tests of Air-Brake Hose.

The noon hour having arrived, topical discussions were taken up, under a rule which allowed ten minutes only to each topic, unless the time was extended by a vote of the association. The first subject was "Tests of Air-Brake Hose." Mr. Barr opened the discussion by stating that he had for some time been testing hose by fixing one end and attaching the other to a moving crosshead which traveled far enough to give the hose an amount of distortion almost sufficient to kink it. Different brands of hose varied to such an extent that the range of endurance was from 200 to 2,800 hours. The hose almost invariably failed near the nipple. While not convinced that this form of test is all that is desired, Mr. Barr is of the opinion the results show clearly that in the effort to make hose that will stand 700 pounds' pressure, the manufacturers have made the hose too stiff and inelastic. He is now trying cotton-covered hose capable of standing 300 pounds air pressure and of much more elastic nature than the common hose. Numerous questions were asked by members, in answering which Mr Barr stated that the failures at the end compared to those in the middle were as 4 to 1. Mr. Schroyer considered that the quality of the rubber determined the flexibility and durability of the hose.

Pressed Steel Trucks.

The next subject was "Pressed Steel Trucks." Mr. Higgins said that there were 90.000 pressed steel trucks in service in this country and that the type had passed beyond the experimental stage. Among the advantages of the pressed steel truck he enumerated the decreased weight, fewer parts, less liability of getting out of square, and improved riding of cars. The saving in weight varied from almost nothing to as much as 2,000 pounds, according to the design of the diamond-frame truck to which it is compared. The fewer parts meant a saving in the cost of inspection and repairs, and the squareness of the truck resulted in fewer sharp wheel flanges and easier haulage. The improved riding of the cars, due in part to placing the springs over the axle-box, is attested by the disposition of the train men to ride on such cars when not in the caboose. The claim for reduced cost of repairs is supported by several cases, in one of which only $1 was spent on these trucks for every $10 expended in repairs to an equal number of diamond trucks. The two kinds of trucks were in the same service, but the pressed steel trucks were only one year old while the others were three years old. The arguments in favor of the diamond-frame truck are the saving in first cost, repairs more easily made after wrecks, greater facility for inspection of wheels, and the ease with which wheels can be changed. Of these the facility for inspection and reduced first cost are admitted, but the experience of Mr. Higgins is that the pressed steel trucks come out of wrecks in better shape, and that it frequently happens that cars so equipped can be hauled from a wreck on their own trucks when diamond trucks are a total wreck. The difference in the cost of changing wheels he also considers to be less than is generally supposed. For large capacity cars, the pressed steel truck seems to be far in the lead. There is, fur-

thermore, a possibility of arriving at a standard truck through this type.

Mr. Sanderson had tried pressed steel trucks in heavy service, and the results were not satisfactory. He does not consider that a modern pressed steel truck should be compared with old diamond trucks, but with the most modern and best designed of that type. The changing of wheels at small interchange points he held to be a difficult matter with pressed steel trucks. Mr. Rhodes called attention to the fact that in modern diamond-frame trucks the number of parts had been generally reduced.

Break-in-Twos.

The next subject discussed was "Break-in-twos." Mr. Waitt started the discussion by stating that he had been investigating the matter on the Lake Shore road and had regular reports of all break-in-twos, whether resulting in damage or not, and he had found that for the first five months of 1896 the number had been 467. This included yard and road service. Of these breakages 45 per cent. were between cars equipped with link-and-pin couplers or where an M. C. B. coupler and a link-and-pin bar were coupled together. Knuckle opening in M. C. B. bars was responsible for 26½ per cent. of the total failures and 21 per cent. were caused by the bar pulling out through either a tail bolt or its key breaking or the latter falling out. The remaining 7½ per cent. of breakages were from miscellaneous causes. Of the failures from knuckle opening he had found most of them due to a bad adjustment of the unlocking gear, there not being slack enough in the chain. He had made it a rule that all coupler chains should have at least 2½ inches slack in the normal position and 3 inches if possible.

Mr. Day said that his road used only the Janney, and he could only speak of that bar, but he had found that the old small unlocking pin never gave any trouble, while the later and larger pin frequently jumped and allowed the coupler knuckle to open. Mr. Sanderson said their greatest trouble was with locks jumping up on M. C. B. couplers on the back end of tenders. Mr. F. H. Soule says that the pin will also creep up. The latest Janney lock gives no trouble whatever. He found the most expensive breakages due to failure of tail pins and that pocket drawbars were all right. Mr. Leeds said that his greatest troubles with the tail pins occured where pins 1½ inches or 1¾ inches in diameter had been substituted in interchange for the regular 2-inch pins. Mr. Rhodes considered manufacturers should give attention to the lifting or jumping of locks, and also to the unlocking of couplers with toggles on the locks that could be operated by a severe shock on the other end of the car. Mr. Barr also receives reports of all break-in-twos on his road and endorsed what had been said about pins creeping up and jumping. He found four times as many failures of this kind in M. C. B. bars as in link-and-pin bars. Mr. Potter said it was the duty of the members to place all available information in the hands of the manufacturers, for the railroads alone had the benefits of experience in the use of the bars. Mr. Bronner said that the experience of the Michigan Central had led them to devote more attention to the maintenance of the unlocking gear. The subject was finally disposed of by making it a subject for a committee to report on next year.

Protective Paints.

A short discussion took place on the kind of paint best suited to the protection of trucks from rust, but Mr. Barr cut it short with the sensible suggestion that as the only trouble occurred from the salt drippings from refrigerator cars, it would be easier to keep the drippings off the trucks than to protect them by paint or japan.

Standards and Recommended Practice.

At the afternoon session the first report to be read was that on the changes in standards and recommended practice. A summary of the report is found elsewhere in this issue, and the recommendations of the committee were endorsed with a few minor changes in wording, and ordered submitted to letter ballot.

Mounting Wheels.

The report on "Mounting Wheels," also published on another page, was discussed briefly, particularly as to the need of the "reference gage," and finally ordered submitted to letter ballot. The report on "Metal Under Frames for Freight Cars" was read and the discussion postponed until a later session.

THURSDAY'S SESSION.

This session opened by the secretary reading a letter from Mr. R. H. Wilbur, of the Lehigh Valley Railroad, accompanied by considerable interesting correspondence relating to the operation of English railway clearance houses for rolling stock, and the methods of inspecting and interchanging cars in England.

Location of Air-Brake Cylinders.

The report on the "Location of Air-Brake Cylinders on Freight Cars," an abstract of which we will publish next month, was next read. This report advocates that cylinders on all freight cars, where possible, be located approximately under one of the side sills, and many members opposed it in the belief that the rods and levers cannot be made uniform. On the other hand there were several members who appreciated the convenience it affords for repairs and favored the recommendations. The discussion was cut short by the special order of business at 10 o'clock—the rules of interchange.

Rules of Interchange.

Mr. Adams introduced the subject by giving the history of the inception of interchange agreements, and introduced Mr. John Mullen, now President of the Connecticut River Railroad, who presided at the first meeting called for the purpose. He made a brief address. The report of the Arbitration Committee was then read and used as a basis for revision, and as this report was framed on the rules outlined by the committee of 21, the work of revision was, of course, conducted on the lines of owner's responsibility. The entire code as recommended by the Arbitration Committee was passed without change except in two paragraphs, which changes the committee itself suggested. Other changes were proposed by members, but they were voted down with great regularity. The first of the two changes made was the striking out of the clause fixing the responsibility for cars destroyed upon tracks of roads not members of the association, upon the delivering road. The second change was to add a clause to Rule 5 (new code) by which switching roads are made responsible for new defects which occur on cars while in their position, and they are prevented from rendering bills for parts broken on their roads. The prices given in the committee's report were revised by a special committee that reported at a later session. It was also decided that rulings of the Arbitration Committee during the year on points not fully covered by the rules should be in equal force with the regular rules until the end of the year.

The Metric System.

Noon-hour discussions were next taken up, the metric system of weights and measures being the first subject. Mr. Higgins stated that Wm. Sellers & Company had used the system in its injector department for 20 years and did not consider it a success. Several other members spoke against the system and finally the association adopted a resolution condemning any obligatory use of the system, such resolution to be sent to the committees and individuals in Congress interested in the bills which are at present before that body.

Double Buffer Blocks.

The use of double buffer blocks in connection with M. C. B. couplers was next discussed. Mr. E. D. Bronner advocated them, claiming that the cost is about $5 per car and the reduced cost of maintenance of the draft gear will offset this. The horn of the coupler is not suited to take the buffing strains, as it is not in direct line and is not of sufficient area. Properly placed the buffer blocks had not in Mr. Bronner's experience given any trouble in coupling on curves. Mr. Sanderson thought the buffers the cheapest thing available to take the buffing strains. Mr. Rhodes said that before the M. C. B. couplers had been adopted the buffer blocks were used in the East and were only kept off Western equipment because of the prejudice against them, they being known as "man-killers." When the M. C. B. coupler was adopted the Western roads hoped to be able to employ the buffer blocks, but the Eastern lines discarded them at this time, and managers of Western lines quoted this action

as a reason why they should not put them on. The C., B. & Q. R. R. decided a few months ago that all its cars with M. C. B. couplers should be fitted with buffer blocks. Mr. Mitchell said that of the 44,000 freight cars owned by the Erie Railroad only about 2,000 cars were without buffer blocks, and it was a very unusual thing to have an M. C. B. coupler head broken off any of their own cars. Mr. Schroyer believes in buffer blocks. Experiments made by him show that a drawbar spring of 20,000 pounds capacity is entirely compressed by a car and its load having a total weight of 40,000 pounds striking a car of the same weight at a speed of four miles per hour. As these speeds are exceeded in nearly every switching movement, the need of buffers is apparent. A vote was passed to the effect that the question of the use of buffer blocks in connection with M. C. B. couplers should be submitted to letter ballot for recommended practice.

Location of Air-Brake Cylinders.

The afternoon session opened with a continuance of the discussion on the report on the location of air-brake cylinders. Mr. Rhodes described some experiments being carried out on the C., B. & Q. R. R., in which a plain tee was placed in the train pipe instead of the drain cup, and the cup itself located at an angle in the branch pipe and so designed that the screen can be readily removed for cleaning. Mr. Rhodes stated that he was not sure of the wisdom of making any change, but gave the description as a matter of possible interest. Mr. Cloud was requested to state the view of the manufacturers in regard to the construction of the drain cup and said that in their opinion the difficulties were overcome by the adoption, about two years ago, of a stronger screen, made of perforated metal. The stopping up of screens only occurred in parts of the surface not in the direct path of the air, and did not become serious enough to prevent action of the brake. As for leading the branch pipe out of the top of the cup, it required several more joints and unless it is a real necessity it is undesirable.

Axle and Journal Box for 80,000-Pound Cars.

The next report to be read was that on the "Axle, Journal-box, Bearing and Wedge for 80,000-Pound Cars," an abstract of which we publish on another page. This admirable report was so complete that it did not admit of much discussion, and after a brief consideration it was decided to submit the designs to letter ballot as recommended practice for one year, and the standing committee on standards were instructed to report on their behavior in service at the next convention, with a view of adopting them as standards if satisfactory.

FRIDAY'S SESSIONS.

Metal Underframes.

The report on metal underframes for freight cars was again discussed, the members having in the meantime visited the various steel cars on exhibition. Mr. Sanderson spoke of the prospect of scarcity of wood in the near future and the tendency toward lower prices for steel shapes as favorable to the prospects of the steel car. He objected to the use of truss rods in steel cars. The greater ability of the steel car to resist the forces of collision is attested by experience with metal tender frames. Mr. Barr said the steel-car question was growing and while the cost was in the way now, the day was coming when it would not be; he therefore moved that five members be appointed, each working independently, to present a design of a steel underframe at the next meeting. This motion was carried and the executive committee will appoint the five persons later. Mr. Bush said that while the cost of the steel cars was now an obstruction to their adoption, the present difficulties would be overcome only by earnest individual effort, and he had therefore promptly seconded Mr. Barr's motion.

Mr. Joughins gave the results of the use of steel cars on the Norfolk & Southern. A sample car built four years ago had not had one cent expended on its frame for repairs. The road had a number of the cars built last year at a cost of from $40 to $50 more than the cost of wooden cars. The weight of the flat cars without brakes is from 19,500 pounds to 20,000 pounds, and the capacity 40,000 pounds. He thinks rivets may be all right but believes that properly fitted bolts are fully as acceptable if no actually better. He does not believe it is necessary to go to patented shapes or construction to obtain a good car. Mr. Stirling, of the Universal Construction Company, claimed that patented articles had contributed much to the progress in railroading, and that there were no serious difficulties in the way of using patented shapes in car construction, as the very existence of the business of a concern advocating such shapes depends on the availability of materials for repairs.

Laboratory Tests of Brake Shoes.

The report on "Laboratory Tests of Brake Shoes' was next read, Before discussing it the report of the joint committee on road and laboratory tests of shoes was read. It stated that present knowledge indicate that on chilled cast-iron wheels in freight service, wrought iron shoes, Congdon, hard and soft cast-iron shoes will give the best service, and at present prices, their economic value will be in the order named. On chilled cast-iron shoes in passenger service, where the pressures and speeds are higher, wrought iron, pressed steel, Congdon, hard and soft cast-iron shoes will give good results and their value is in the order named. For steel-tired wheels no recommendation can be made because the quality of the steel has so much influence on the action of the various shoe metals. The discussion brought out little additional information except that Mr. Barr stated he had found the varying thickness of flanges on cast wheels made it inadvisable to use flanged shoes on those wheels. The committee on brake-shoe tests was made a standing committee.

Passenger Car Ends and Platforms.

The report on "Passenger Car Ends and Platforms" was next presented. An abstract of this report will appear in our next issue. The design recommended by the committee embodied good points from many of the platforms in use at present and in the discussion the committee said that the Eastern Railroad Association had given the opinion that it infringed in some respects on existing patents. The design was therefore presented as representing the best practice, and roads would understand that if they used it they would have to pay royalties on some features of it.

Freight Car Doors.

The report on "Freight Car Doors," published elsewhere in this issue, was next taken up. In the discussion an attempt was made to have the committee continued for another year to present a design of car door and fastenings free from patents and capable of meeting all requirements, with a view of having the design adopted as a standard. A parliamentary tangle ensued which was straightened out by referring the matter to the Executive Committee.

Power Brakes and M. C. B. Specifications.

The noon hour having again arrived, topical discussions were taken up, the first one being, "Will a railroad company be conforming to the law requiring power brakes on cars, regardless of whether its brakes meet the specifications adopted by the M. C. B. Association?" The legal aspect of the question did not receive much attention, but the discussion was most emphatically in support of the resolution with which it closed, and which was proposed by Mr. Mitchell, namely, that "It is the sense of this meeting that brakes whose triples have not met the test of the M. C. B. Association shall not be considered as proper brakes for use on railway equipment."

Pockets vs Tail Pins.

Mr. Hennessey presented an argument in favor of pockets instead of tail-pins in draw-gears. He said that the only arguments for the tail-pin were first cost and ease of removal for repairs; every other point is in favor of the pocket. As showing the greater safety of the latter, he said that of the 27,880 cars on the C., M. & St. P., 95 per cent. were equipped with pocket bars, and in two years only 14 had failed, causing a total damage of $871. In the 5 per cent. equipped with tail-pins, there were 17 failures, costing $2,300. Mr. Mitchell offered a resolution that it was the sense of the meeting that tail-bolts should be abolished, and it was carried.

Mending Air-Brake Hose.

The next topic was the mending of air-brake hose, and Mr. Rhodes produced several samples that had been spliced or in which punctures had been closed with cement, at costs ranging from 7¼ cents to 10 cents. As the first cost of the hose is 70 cents the saving is considerable.

Lead Lined vs. Filled Brasses.

A discussion on solid lead-lined brasses vs. filled shell bearings for freight cars brought out the fact that either worked well when properly made, the chief trouble with the shell brass being the small bearing on the axle if the filling is melted out by a hot journal. On the other hand if the shell is rightly made even this difficulty can be overcome. The lead-lined solid brass is evidently the favorite, however.

Substitution of Triples.

After discussing the right of a company to substitute one make of triple valve for another in cleaning or repairing brakes under the interchange rules, it was decided that such substitution is not proper repairs.

Uniformity in Car Construction.

Mr. Soule opened a discussion on the question : "Is it desirable to have greater uniformity in car construction?" He suggested adding to the present standards certain standard dimensions for center plates and side bearings. While not ready for such a step now, the association would also, he thought, find it desirable at some future time to adopt standard shapes for metal underframes, with several standard lengths for each shape. Mr. Peck thought the draft rigging should be standardized, and Mr. Hennessey urged standard sizes of iron for arch bars.

Handholds.

The afternoon session opened with a consideration of the report on "Handholds and Heights of Drawbars." The recommendations of the committee were amended by omitting the handhold in the center of the end of the car, 4 feet 3½ inches above the rail.

Coupler Unlocking Gears.

The report on "Unlocking Arrangements for M. C. B. Automatic Couplers" was next presented and discussed. The report gave considerable information about present devices, but recommended no particular design, and members desired from the committee a design which would meet the requirements of as many couplers as possible. They were consequently instructed to prepare such a design and present it next year.

Stenciling Cars.

The report on "Stenciling of Cars," found elsewhere in this issue, was next received and the recommendations contained in it ordered submitted to letter ballot.

Mr. Leeds, as Chairman of the Committee appointed on Wednesday's session to report on "Loading Poles, Rails, Etc.," presented the report, the recommendations in which will be submitted to letter ballot.

Resolutions of thanks to those who had extended courtesies to the association were carried unanimously. The election of officers resulted as follows: President, S. A. Crone; First Vice-President, E. D. Bronner; Second Vice-President, C. A. Schroyer; Third Vice-President, J. T. Chamberlain; Treasurer, G. W. Demarest; Executive Committee, G. W. Rhodes, P. Leeds and M. M. Martin.

A call for suggestions for the next place of meeting led to the proposal of the following places: Old Point Comfort Niagara Falls, Chicago, Denver, Montreal.

Adjourned.

On May 7 the Michigan Central made a fast run over its Canada Southern division, covering the distance from Windsor to Fort Erie, 229.4 miles, in 3 hours, 34 minutes, 59 seconds, or at the rate of 64.02 miles per hour. One stop was made at St. Thomas, of 4 minutes and 40 seconds, so that the average speed for the actual running time was 65.45 miles per hour. The train consisted of three cars weighing 230,000 pounds, or 115 tons, and was hauled by a 19 by 24 ten-wheeled engine with 68-inch drivers, carrying 160 pounds of steam. The engine weighs 96,300 pounds on the drivers and 27,200 pounds on the truck, or a total of 123,500 pounds.

AMERICAN RAILWAY MASTER MECHANICS' ASSOSOCIATION.

Proceedings of the Twenty-ninth Annual Convention.

The twenty-ninth annual convention of the American Railway Master Mechanics' Association opened in Saratoga, N. Y., June 22, 1896, President Blackall presiding. After an opening prayer the association listened to an address of welcome from the president of the village. Mr. Blackall then presented his annual address. It was business-like and pointed, and besides touching on the work of the association and of the railroad clubs, dwelt upon some of the advances in railroad practice during the year, among others improved counterbalancing of locomotives, reduction of the weights of reciprocating parts, and rating engines on the tonnage basis. He said that economy had been the watchword with all railroad officials during the year, and a better fuel efficiency is being sought everywhere. Another important matter to which attention is being directed is the improvement in the condition of the men in the employ of the railroad companies.

The Secretary's and Treasurer's reports showed the membership to be 683 and the balance in the treasury $813.34. The Secretary's report called attention to the fact that the association scholarships at the Stevens Institute had not been fully improved, the chief difficulty being that after one year's shop experience (as required by the association) the candidate is not familiar enough with his scientific studies to meet the severe entrance examinations.

The whole matter was referred to a committee that at a later session made a report in which they notified the Association that at the next meeting they would move to amend the constitution by modifying Article 7 to provide that if the scholarships are not filled at the spring examinations by sons of members, railroad employees or sons of railroad employees may compete at the fall examinations.

Another amendment to the constitution presented last year was adopted at this time, by which the Secretary of the association was made an appointee of the Executive Committee. After this action another amendment was proposed for action next year, by which the Secretary is not to be a member of the Executive Committee. and providing for three Vice-Presidents instead of two as at present.

The attention of the association was called to a report of the New York Railroad Commission, in which radial stay boilers were condemned as less safe than crown-bar boilers. The subject was made a special order of business for Tuesday at noon, and the Commission invited by telegraph to be present.

A motion condemning the obligatory use of the metric system was adopted. A resolution endorsing the work of the Master Blacksmiths' Association was passed. Mr. Henderson read a letter from Mr. Bond, of the Pratt & Whitney Company, in which it was stated that the concern had overcome the difficulties in sawing the finest slots in the new decimal gage and would in a few days be ready to deliver the first lot of 500 gages. The Schenectady Locomotive Works invited the association to visit the works. This invitation was accepted and the time fixed for 2:30 Tuesday afternoon.

Exhaust Pipes and Steam Passages.

The first of the reports from committees to be considered was that on "Exhaust Pipes and Steam Passages," a summary of which we publish on another page. This valuable report is voluminous and accompanied by many diagrams, and as none of the members had received any copies of it before coming to the meeting, the discussion was altogether in the nature of interrogations addressed to the committee. The committee was continued for another year with the understanding that a number of roads would be asked to make practical tests of pipes and stacks of the form recommended by it.

Connterbalancing Locomctives.

The report on "Counterbalancing Locomotives," found elsewhere in this issue, was next presented. The Chairman, Mr. Herr, explained that the rule recommended in the report, while undoubtedly correct in principle, should be tested in practice, in order to make sure that the coefficient of $\frac{1}{400}$ of the weight of the

engine was best. He said that whether that amount of the reciprocating parts could be left unbalanced or not might be found to depend in a measure on the length of the rigid wheel base and its effect in resisting the lateral swaying of the engine. It might in a similar manner be influenced by the weight on the truck. Mr. W. H. Marshall said that it might also be influenced by the total length of the engine; that there were, for instance, many 10-wheeled engines running weighing from 100,000 to 130,000 pounds, and, on the other hand, many modern 8-wheeled engines of the same weight. The latter were, however, considerably shorter than the former, and the difference in distance from the center of moments of such heavy parts as cylinders at the one end, and foot plates, etc., at the other, would have an effect on the coefficient. Mr. Leeds said that in a number of cases of bent rails he had investigated, the damage had always been done at speed in excess of 48 miles per hour. In each case the engine had the correct total amount of counterbalance, but it was not properly distributed among the wheels, there being a shortage in the main wheels and an excess in the others. After a general discussion on the present practice in counterbalancing, the committee was continued and instructed to make arrangements with a number of roads for practical trials of the proposed rule during the year and report the results at the next convention.

Slide Valves.

The third report to be considered was that on "Slide Valves," which we publish in abstract. Mr. Quereau called attention to the fact that the Allen valve not only had the advantage of the large port opening at early cut-off, but that it was possible with it to greatly reduce the lead, with the result that at a six-inch cut-off the exhaust opening could be delayed about three-quarters of an inch and the exhaust closure delayed nearly one inch, resulting in an increased mean effective pressure of from five to eight per cent. Mr. Herr said that on the Chicago & Northwestern Railway they had been able to add four or five cars to a 40-car train by reducing the lead with a plain valve. Mr. Forney asked if members had found any saving in fuel resulting from the use of the Allen valve. Mr. Forsyth said that he was also interested in that point and was sorry the committee had not considered it in the report. Mr. Vauclain and Professor Goss both testified to the fact that engines were frequently run with too early a cut-off, and that there was no economy in making it less than six inches. Considerable discussion took place on the appearance of some of the indicator diagrams in the report and the fact was brought out that the springing of the valve gear of the average locomotive, made the duplication of results extremely difficult and would probably explain the vagaries in the diagrams.

TUESDAY'S SESSION.

Reciprocating Parts.

Tuesday's session opened with the reading of the report on "Reciprocating Parts," which will be published in abstract in a later issue. The malleable iron piston of the Norfolk & Western Railroad, illustrated in the June issue of this journal, attracted considerable attention. Mr. Vauclain said he had used a somewhat similar piston of cast steel with the bearing ring screwed on. Hollow piston rods were mentioned as a means of reducing the weight of reciprocating parts, but the cost is considerable. Mr. McKenzie called attention to the fact that some of the illustrations in the report showed no shoulders at the taper fit of the rod in the piston head and crosshead. He had not been able to make that construction a success. Mr. Forsyth said that its success depended on the density of the materials employed. If the metal surrounding the rod is soft and ductile, it will stretch and produce a loose fit, but if hard enough the fit will remain perfect. Mr. Thomas, of the Southern Railway, said he had used steel pistons with cast-iron rims cast on to them to obtain a suitable metal for contact with the bore of the cylinder.

Cylinder Bushing.

The report on "Cylinder Bushings,' published on another page, led to animated discussion on the best material for cylinder castings. Some members thought that if a strong, tough iron was employed not only the strength but also the wearing qualities would be all that is required, and that the false valve seats and bushings should not be applied to new engines. Cases were cited where engines had run from 14 to 20 years without being bushed. The advocates of bushing new cylinders held, however, that powerful modern engines had given trouble from the breaking of cylinders and saddles and that, when the metal is made strong enough to resist the strains to which it is subjected, it is not found to have as good wearing qualities as in older and smaller engines. The bushings and false valve seats permit the use of a strong metal for the main casting, regardless of its wearing qualities, while these parts can themselves be made of harder and more durable metal than it would ever be possible to use in the main casting. Some cases of reduced fuel consumption on account of the reduction of the friction by the use of hard bushings and valve seats were cited. The cost of bushing is not great, one member saying he could bush a 20 by 24-inch cylinder for $17, and Mr. Vauclain stating that the Baldwin Company's price for bushing the cylinders and valve chambers of a four-cylinder compound locomotive (six bushings) is $125.

Hub Liners.

The report on "Hub Liners" gave several examples of the best current practice. The discussion touched on the babbitting of journal box faces, with which some members had excellent results. Some were in favor of cast iron and others advocated brass as the material for liners. One member uses a liner in two parts bolted together by means of lugs so far from the center of the axle as to be beyond the wheel hub. They clamped firmly on the axle and had the advantage that they could be applied without taking out the wheels. Some members use the liners on new engines, others only in repairs.

Radial Stay vs. Crown Bar Boilers.

The noon hour having arrived, and Mr. Rickard, of the New York Railroad Commission, being present, the question of the relative safety of radial stay and crownbar boilers was discussed. Mr. Rickard read from his report the paragraph that had attracted the attention of the association. It is as follows:

"In the explosions of locomotive boilers, which have taken place in this State, in several years past, many of them have been of boilers with crown-sheets supported by radial stays. While there have been exposions of boilers where the fireboxes have been constructed with crown bars and rivets, the complete destruction of fireboxes in the former type was absent in the latter. Much has been said, and more may be said, as to the relative merits of crown bars and radial stays in such construction. The Board believes this is a subject which should receive the earnest consideration of all persons engaged in boiler construction."

The discussion was almost wholly on the relative merits of the two general types and nearly all of the testimony was in favor of the radial stay boiler. It was shown that instead of the Commissioner's report being in accordance with facts the very reverse of its statements was true, the radial stay firebox often coming down when hot without excessive damage, while the crown bar boiler usually exploded disastrously when the water was allowed to get too low. The Commission had apparently arrived at its conclusions from experience with wide firebox engines, and had not gone into the matter far enough to ascertain whether the trouble was due to faulty construction, imperfect inspection and maintenance, or defects in the general type, but unfortunately these things did not receive consideration in the discussion. The association confined itself to a comparison of the two general types, and terminated the discussion by passing a resolution to the effect that the radial stay boiler is as safe as the crown bar boiler, is easier to keep clean, and more economical in repairs.

Steam Pipes and Joints.

The last report to be considered at this session was that on "Steam Pipes and Joints." The discussion was brief, and did not bring out much that was not already touched on in the report. The report appears elsewhere in this issue.

WEDNESDAY'S SESSION.

The Apprentice Boy.

The first report at this session was on "The Apprentice Boy." This report dwelt chiefly on the possibility of giving apprentices opportunities for instruction in the sciences and the methods to be

employed in furnishing the instruction. Mr. Briggs said that employers had but little control over the boys and the trouble was chiefly with the labor organizations. President Smart, of Purdue University, said that Purdue was in a helpful mood, and if there was any work which it could undertake for the better instruction of apprentices it would gladly co-operate with the association. The university is already perfecting the plans for a mechanics' institute, but feels that in the instruction of apprentices it must first find out what was needed. Mr. Forsyth noticed that the committee said they could not recommend an apprentice system. He believes they can, and that they should be requested to report at the next convention an outline of shop instruction and also an outline for technical instruction.

Mr. Miller said that apprentices should be required to come up to a good moral and physical standard, and in dealing with them it should be borne in mind that some were ambitious, and would endeavor to fit themselves for something higher than a mechanic, while others would be content to be good workmen. Mr. Herr said that a proper shop training is the most important consideration, and it appeared to be wholly ignored by the committee. The great question is how can we handle the boys in the shop so that they can most improve their opportunities. Mr. McKenzie said that his practice was to make a careful selection from among the many applicants, and to give each boy a trial of one year at a certain pay. If at the end of that period he had made creditable progress his pay was increased. If his work was unsatisfactory he might be permitted to continue for another year, but if he then failed to make a good showing he was dropped. Mr. Barr though the subject a large one, and believed that the various railroad clubs could discuss it with profit. Mr. Quayle thought it important to advance the boys as rapidly as their ability and efforts warranted, and not discourage them by keeping them on one class of work longer than was right. On the C. & N. W. Ry. he divided apprentices into two classes—those with a common-school education, who were carefully instructed in regular shop practice—and those with a technical education, who were given a special shop course, and to whom were also assigned special investigations and other work that would fit them for advanced positions.

Driving Box Wedges.

The report on "Driving Box Wedges" was next considered. Mr. McKenzie believed that stationary wedges to be successful should have wide faces. The frame jaws should be at least 5 inches and the shoes 8 inches wide. He recently had some 10-wheeled engines built with front and back pedestal jaws parallel and the main jaws taper. The greatest trouble with fixed wedges was in the use of shims, there being considerable pound at the boxes before even very thin shims could be inserted. Mr. McIntosh said that the way to overcome that trouble was to fit the stationary wedges when new with shims, say ¼ inch thick, and then to have other shims varying in thickness by hundredths of inch. These could be substituted for the original shims when the least pound appeared.

Engine and Tender Steps, Etc.

The report on "Engine and Tender Steps" published elsewhere in this issue was not discussed. The report on "Truck Brake Hangers" had not been printed. It was read, but the members were not, of course, able to discuss it. The report on "Locomotive Grates" was deferred until next year.

Thickness of Wheel Flanges.

The report on "Thickness of Wheel Flanges" recommended: 1. That the minimum thickness of leading engine truck-wheel flanges should be the same for both iron and steel wheels; 2, That the minimum thickness be 1 inch, measured at a point ⅜ inch from the top of flange, as shown on the appended diagram, Fig. 3. In recommending that the steel-flange limit be the same as in cast iron, the fact that the strength of steel admits, with perfect security, of a thinner flange has not been lost sight of by the committee. The recommendation is based purely upon economical considerations as to tire wear.

Some members endeavored to have the convention go on record regarding the safety of a wheel flange ⅞ inch thick, but the association refused to express an opinion, and passed a resolution to the effect that the minimum limit of flange thickness should be 1 inch, and that in the measurement of the flange the M. C. B. flange gage should be employed.

Boiler Tubes.

The report on the thickness of boiler tubes was adopted, and the standard of the association made to conform therewith.

Resolutions of thanks to all who had extended courtesies to the association were passed. The commitee on subjects for next year reported twelve subjects, which were referred to the Executive Committee. A resolution was passed recommending that locomotive performance sheets be made out on the ton-mile basis instead of the car or train-mile basis.

The election of officers resulted as follows: President, R. H. Soule; First Vice-President, P. Leeds; Second Vice-President, R. Quayle; Treasurer, O. Stewart. The Executive Committee met after adjournment and appointed John W. Cloud as Secretary.

Mr. John McKenna and Mr. A. Galloway were elected honorary members. A test vote on the next place of meeting resulted in more than two-thirds of the votes being cast in favor of Colorado Springs. Other places mentioned were Old Point Comfort, Bar Harbor, Niagara Falls and Chicago.

Adjourned.

THE MOST ADVANTAGEOUS DIMENSIONS FOR LOCOMOTIVE EXHAUST PIPES AND SMOKESTACKS.*

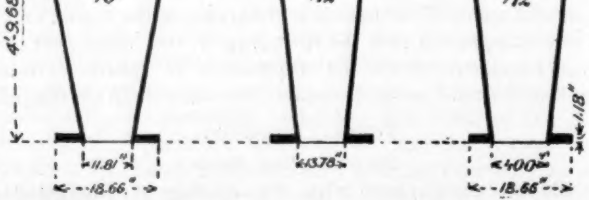
BY INSPECTOR TROSKE.

(*Continued from Page 86.*)

V.—Experiments with Conical Stacks Without Waists.

In order to determine the influence of the waist, similar experiments were made with the three funnel-shaped stacks, that have already been mentioned. Their forms are given in Fig. 37, and they

Fig. 37.



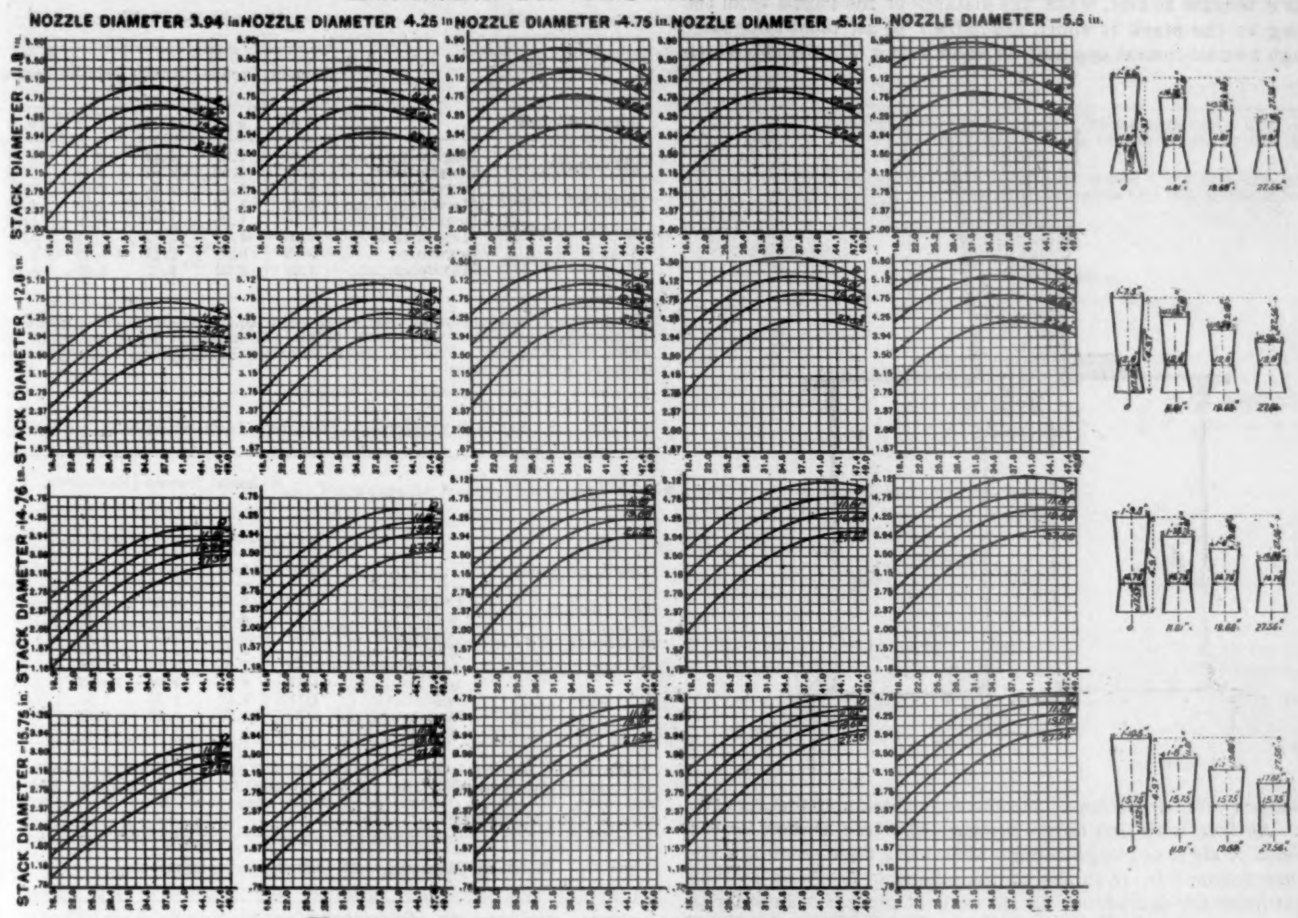
have exactly the same length from the bottom to the top, as the stacks with the waist inclusive of the foot or flare at the bottom, which was 4 feet 9.68 inches. At their lower ends, plates 1.18 inches thick, and 1 foot 6.66 inches outside diameter were riveted, in order that they might be placed upon the rings that have been described. These rings were packed with wicking in this instance also. The shortest distance of the nozzle from the smallest section of the stack was 1.38 inches, and was increased by steps of 1.57 inches to 31.3 inches.

The three stacks were also shortened three times. The results obtained are shown in Plates IV. and V. In these plates, as in Section II., the zero for the abscissas of the nozzle locations is taken from a point 17.52 inches above the lower end of the stack, in order that the abscissa values in all of the plates may be the same.

The most important results obtained with these funnel-shaped stacks are that, when the abscissas on the scale lines ranged from 23.62 inches to 39.37 inches, which means that the nozzle was from 6.1 inches to 21.85 inches below the actual bottom of the stack (that is, from its point of smallest cross-section), the vacuum lines were straight, which means that the vacuums produced varied directly with the increase in the nozzle distance. The relations existing between vacuum, nozzle pressure and nozzle position are here of the very simplest nature. In the diagrammatic representations

* Paper read before the German Society of Mechanical Engineers, and published in *Glasers Annalen für Gewerbe und Bauwesen.*

III. SHORTENED CONICAL STACKS WITH AN INCLINATION OF 1 IN 6.



IV. SHORTENED CONICAL STACKS WITHOUT WAISTS

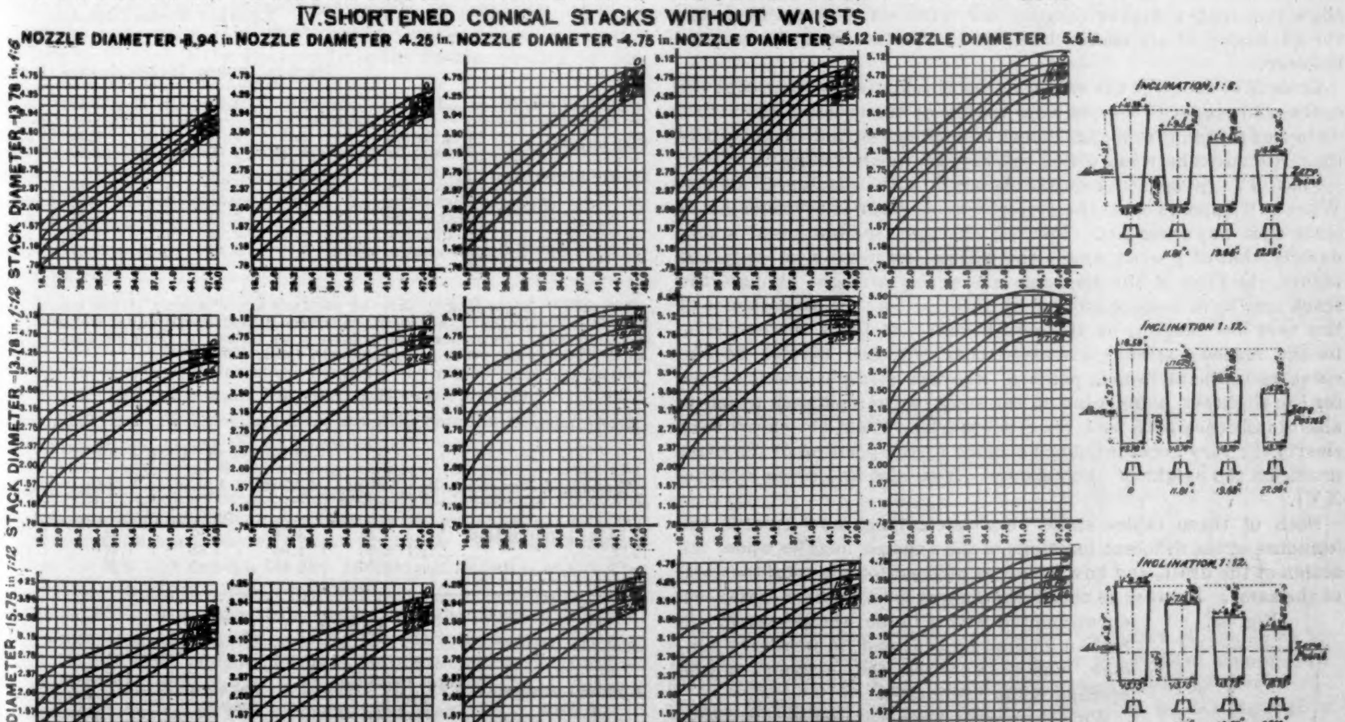


PLATE IV.—DETAIL DIAGRAMS OF THE HANOVFR SMOKESTACK AND EXHAUST NOZZLE EXPERIMENTS.

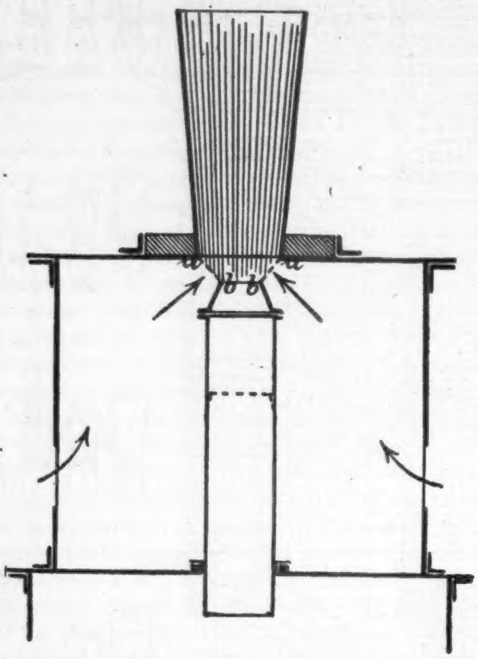
NOTE 1.—The absciss r (nozzle positions) in stacks without a waist are measured from a point 17.52 inches above the bottom of the stack and 18 90 inches above the highest portion of the nozzle.

2.—The four curves drawn beneath one another are measured from the same base and represent the vacuums produced by the full length stack and the same shortened three times. The amount of each shortening (11.81 inches, 17.68 inches and 27.56 inches) is marked at the right hand end of each.

the first portion of the line, corresponding to nozzle positions of from about 18.9 inches to about 23.62 inches (which is from 1.38 inches to 6.1 inches from the smallest section), curves sharply.

This is because at first, when the distance of the nozzle from the opening to the stack is short, the indraft of air must take place through a small conical opening as shown at *a b* in Fig. 38, which

Fig. 38.



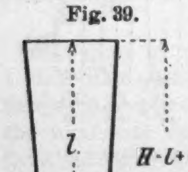
represents a vertical section of the current of steam as it enters the stack. At first, with that nozzle distance, the free section for the admission of air is not large enough to secure a high vacuum without obstruction. In the lines of the diagram in Plate IV. the straight lines are dotted out to the axis of ordinates, in order to show that with a higher vacuum the influence of a small area for the admission of air makes itself felt as well as when the vacuum is lower.

Table XV. (*a*) gives the values of the three principal points of the curve, and, under *b*, the limiting values of the vacuum for nozzle distances ranging from 23.62 inches to 39 37 inches, and consequently those distances between which the vacuum line is straight.

Plate IV. gives the results obtained with shortened stacks. Whence it appears that the straight lines recur in every length of stack that was examined. For the sharpest inclination of stack, namely that of ⅛, even where the nozzle diameter was only 3.94 inches, the lines of the diagrams are nearly straight though the stack may have been shortened by 27.56 inches. In consequence of the very low vacuum at the outset (only 0.83 inch), the result is, for the reasons already discussed, that the first portion of the curve up to the 23.62-inch. point is likewise straight, but it curves for the slightest shortening of the stack, a circumstance which is also of influence with both the other stacks. Plate IV. shows very clearly the very great influence exerted by the position of the blast nozzle on the height of the vacuum. It is also laid down in Table XVI.

Both of these tables show very conclusively how great is the influence of the different locations of the exhaust nozzles upon the action of the draft, and how it can be utilized for the total increase of the same. In order to obtain the figures for a slight increase, we experimented with a funnel-shaped stack. It had an inclination of ⅛, and its smallest diameter was 13.78 inches, the exhaust nozzle opening being 3.94 inches.

Fig. 39.



With the nozzle down 3.94 inches this stack, which had a length of 4 feet 9.68 inches, gave a vacuum of 1.97 inches as given by the lines of the diagram under IV. in Plate IV. If this stack be shortened 11.81 inches (300 millimeters) at the top, the same vacuum can be obtained by increasing the nozzle distance only 3.15 inches. With the stack shortened 19.t8 inches at the top, the nozzle distance must be increased from 3.94 inches to 10.24 inches. In like manner with the total height of the stack lessened by from 8.66 inches to 13.37 inches, the action of the draft remained unchanged:

Now if we reduce both of these shortened stacks back to their first total height, and allow for the original location of the nozzle

TABLE XVI.—SHORTENED STACKS.
(*Conical Stacks Without any Waist.*)
1. Stack Diameter = 13.78 in. Inclination of ⅛.

		Exhaust Nozzle Diameters.				
		Inches.	Inches.	Inches.	Inches.	Inches.
Length of stack		3.94	4 33	4.74	5.12	5.51
Full Length	Beginning	1.61	1.89	2.17	2.40	2 58
	Maximum	4.09	4.49	4.94	5.12	5.19
Shortened 11.81 in.	Beginning	1.34	1.57	1.81	2 00	2.19
	Maximum	3.94	4.35	4.76	4.92	4.96
" 19 68 in.	Beginning	1.10	1.30	1.50	1.69	1.85
	Maximum	3.80	4.21	4.61	4.74	4.81
" 27.56 in.	Beginning	0.83	0.98	1.14	1.30	1.42
	Maximum	3.62	4.02	4.37	4.48	4.49

Remarks: The starting or beginning value of the vacuum corresponds to the shortest distance of the nozzle below the smallest cross-section of the stack, or 1.38 inches. The maximum likewise corresponds to the greatest distance, or 31.30 inches.

2. Stack Diameter = 13.78 Inches: Inclination of $\frac{1}{12}$.

		Exhaust Nozzle Diameters.				
		Inches.	Inches.	Inches.	Inches.	Inches.
Length of stack		3.94	4.33	4.74	5.12	5.51
Full Length	Beginning	2.76	3.08	3.45	3.70	3.90
	Maximum	4.47	4.92	5 28	5.46	5.59
Shortened 11.81 in.	Beginning	2.28	2.52	2.87	3.13	3 30
	Maximum	4.31	4.69	5.11	5.20	5 32
" 19.68 in.	Beginning	1.85	2.09	2.42	2.64	2.80
	maximum	4.17	4 51	4.94	5.02	5.07
" 27.56 in.	Beginning	1.18	1.42	1 73	1.93	2.09
	Maximum	3.90	4.22	4.62	4.79	4 71

Remarks: As in 1, it so happens with the others, that the maximum vacuum is obtained with the 5.12 in nozzle, at an average of 28.15 in. and with the 5.51-in. nozzle at 26.58 in. measured from the smallest cross-section of the stack.

3. Stack Diameter = 15.75 Inches: Inclination, $\frac{1}{12}$.

		Exhaust Nozzle Diameter.				
		Inches.	Inches.	Inches.	Inches	Inches.
Length of stack		3.94	4.33	4.74	5.12	5 51
Full length	Beginning	2.22	2.54	2.87	3.15	3.30
	Maximum	3.78	4.06	4.45	4.69	4.82
Shortened 11.81 in.	Beginning	1 73	2.00	2.32	2.5	2.72
	Maximum	3.48	3.88	4.25	4.45	4.57
" 19.68 in.	Beginning	1.30	1 54	1.81	2.00	2 17
	Maximum	3.30	3.70	4 06	4.23	4.35
" 27.56 in.	Beginning	0.79	0.96	1.18	1 38	1.54
	Maximum	3.15	3.52	3.80	4.00	4.13

Remarks: According to this the vacuum appertaining to the stack, that has been shortened 27.56 inches, increases if the position of the nozzle is dropped from 1.38 inches to 31.30 inches, as noted in Remark 2 with Table XVI. This is shown in percentages in Table XVII.

TABLE XVII.

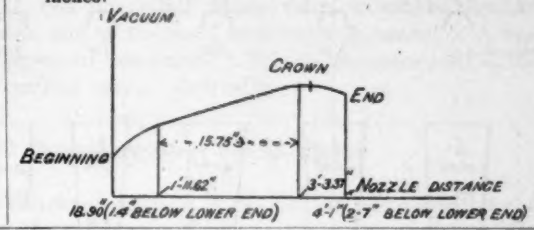
Shape and size of stack	Diameter of exhaust nozzle.				
	3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
	Per cent.	Per cent.	Per cent.	Per cent,	Per cent.
13 78 in. ⅛ inclination	3.38	3.08	2.83	2.45	2.16
13.78 " $\frac{1}{12}$ "	2.30	2.00	1.66	1.47	1.25
15.75 " $\frac{1}{12}$ "	3.00	2.65	2.22	1 90	1 70

TABLE XVIII.

Nozzle Location, inches.	Total height of stack, inches.	Vacuum, inches.	Increase in the vacuum, per cent.
3.94	57.68 + 3.94 = 61.62	1.97	....
3.94 + 11.81 = 15.75	45.87 + 15.75 = 61.62	2.76	40
3.94 + 19 68 = 23.62	38.00 + 23.62 = .62	3.23	64

TABLE XV.—CONICAL STACKS WITHOUT WAISTS.

(*a*.) Vacuums.

Stack.			Exhaust nozzle diameters. Inches 3.94	Inches. 4.33	Inches. 4.74	Inches. 5.12	Inches. 5.51	Remarks.
1/6		Beginning Crown End	1.61 4 09 4.09	1.89 4.49 4 49	2.17 4.94 4.94	2 40 5.12 5.12	2.58 5.19 5.19	1. The abscissas are calculated from a zero point 17.52 inches above the smallest section of the stack, or 18.9 inches above the top of the nozzle. 2. The shortest distance of the nozzle from the smallet section of the stack is 1.38 inches and the greatest is 31.30 inches.
1/12		Beginning Crown. End	2 76 4.47 4.47	3.08 4.92 4.92	3.45 5 28 5.24	3.70 5.46 5.39	3.90 5 79 5.39	
1/12		Beginning Crown End	2.22 3.66 3,66	2.54 4.06 4.06	2.87 4 45 4.45	3 15 4.69 4.69	3.30 4.82 4.82	

(*b*.) Vacuums for Nozzle Distance of from 23.62 Inches to 39.37 Inches (Lines Straight).

Stack Diameter.	Nozzle Distance. Inches.	Exhaust Nozzle Diameters. Inches. 3.94	Difference.	Inches. 4.33	Difference.	Inches. 4.74	Difference.	Inches. 5 12	Difference.	Inches. 5.51	Difference.	Remarks.
13.78 1/6	23.62 39.37	2.17 3.41	1.24	2.48 3 86	1.34	2.85 4.37	1.52	3.08 4.69	1.61	3.27 4.92	1.65	The nozzle distance of 23.62 inches corresponds to a distance of 5.32 inches from the smallest section of the stack, and the distance given as 39.37 inches to one of 21.85 from the smallest section.
13.78 1/12	23 62 39.37	3.35 4 21	0.86	3.70 4.63	0.93	4.13 5.12	0.99	4.41 5.35	0.94	4.61 5.55	0 94	
15.75 1/12	23.62 39.37	2.62 3.35	0.73	2.95 3.72	0.77	3.27 4.09	0.82	3 54 4.39	0.85	3 70 4.57	0.87	

to be increased from 11.81 inches to 19.68 inches (300 to 500 millimeters), the other ratios remaining unchanged, the vacuum will rise from 40 to 64 per cent, as shown in the following table No XVIII.

This marked increase in the vacuum raises the question as to what is the most advantageous relationship to establish between the length of the stack l and the nozzle distance x (Fig. 39) if the total height H, that is the distance from the nozzle opening to the top of the stack, remains the same.

This question is answered by a reference to the examples given in Plate IV.

Let the smallest stack diameter be 15.75 inches and the nozzle diameter 4.74 inches. The total height of the stack measured from the nozzle is taken consecutively as 5 feet 2.99 inches; 5 feet 6 93 inches and 5 feet 10.87 inches.

We illustrate each one of these latter cases as examined in Fig. 40, and we see:

1. That, with the same total height, the vacuum increases with the decreasing length of stack, the nozzle distance being increased by equal increments.

2. That by increasing the total height the vacuum also increases. This is not the only case for the stack with a diameter of 15.75 inches cited here, but also for all of the other stacks whose operation is represented under IV. in Plate IV.

From the foregoing, it follows as a matter of course that the stacks should be shortened at the upper end, while the smallest diameter remains unchanged. In this case the sectional area of the stack becomes more contracted relatively to the current of steam and therein lies the reason for the increasing vacuum as the distance down to the nozzle is made greater.

On the other hand, the question arises as to the effect of shortening the stack from the bottom, leaving the sectional area at the top unchanged. For this purpose we have brought together a group of a few stacks from which the curvature plates have been taken; they are shown in Fig. 41, and from them we see:

1. That with the decreasing length of stack and the corresponding increase of nozzle distance, the total height remaining unchanged, the vacuum decreases, and

2. That the vacuum increases again as the total height is made greater.

The decrease is, of course, so slight within the limits of possible practice, that it is of scarcely any importance at all, and may be entirely neglected. From all of these examples it seems that it is advantageous for a locomotive, next to a large stack, as we have already discussed, (*a*) to choose a liberal total height, and of it (*b*) use about six or seven-tenths for the length of the stack itself, and from four to six-tenths for the distance from its base to the nozzle. A rule that will suffice for locomotive practice is to make the total height four or five times the smallest diameter, whereas the former practice has been to make it from six to six and a half times.

From the data given above it will be seen that the nozzle distance should not be made much more than one and a half times the smallest diameter of the stack. As a general thing, we will secure a suitable relationship if we make the stack from 39.37 inches (1 meter) to 47.42 inches (1.2 meters) long above the waist and the nozzle distance from 17.72 inches to 25.59 inches, which is equal to about 1½ d, as shown in Fig. 42.

Fig. 42.

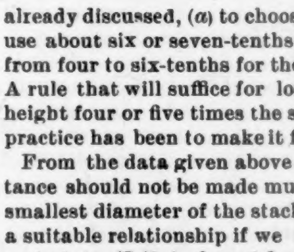
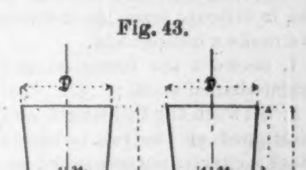


Fig. 43.

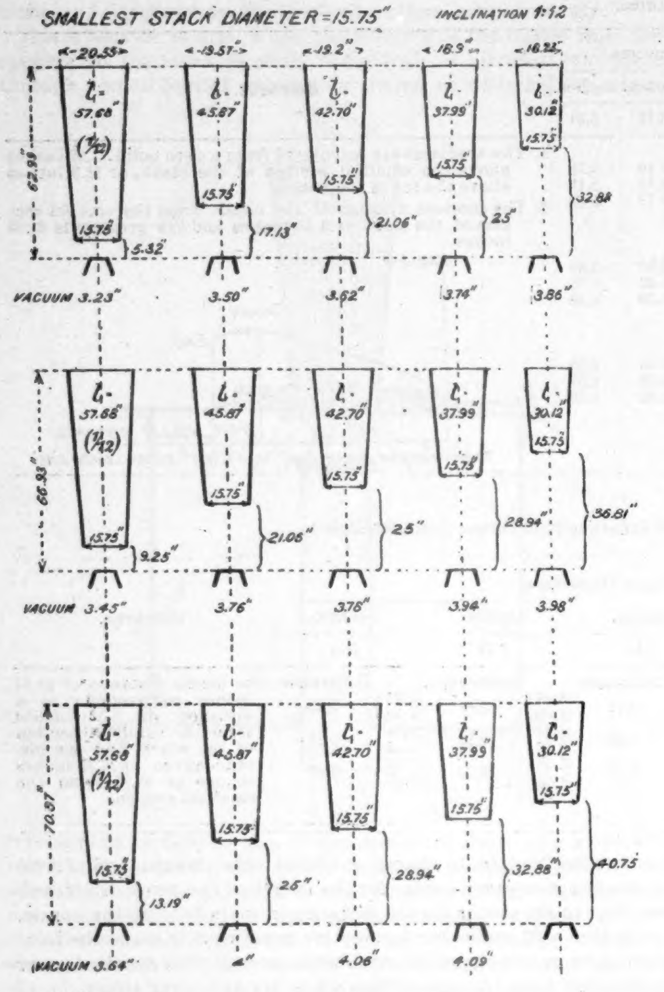


The influence which is exerted upon the action of the stack by the means and method of conducting the products of combustion and the steam to it, is shown in the following investigations:

(a.) Suction of the Products of Combustion by the Current of Steam.

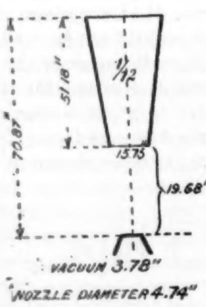
The suction of the products of combustion into the smokebox or air into the apparatus is accomplished in the same way as gas or air would be drawn along by any roughened surface. The inner portion of the stream of steam carries no particles of gas or air with it, so long as it remains closed. Hence the greater the velocity of the steam, or the greater the velocity of the surface of the mantle, by just that amount will more gas be entrained, as is also shown in Section VIII.

Fig. 40.



(b.) *Shape of the Foot ofthe Stack.*

What influence does the shape of the foot of the stack exert upon the vacuum? As the result of experiments, the cylindrical, the conical and the conico-cylindrical shape of stack came to be applied. So, in order to learn the influence of each, we make a comparison.



1, between the funnel-shaped and the waist-shaped stack;

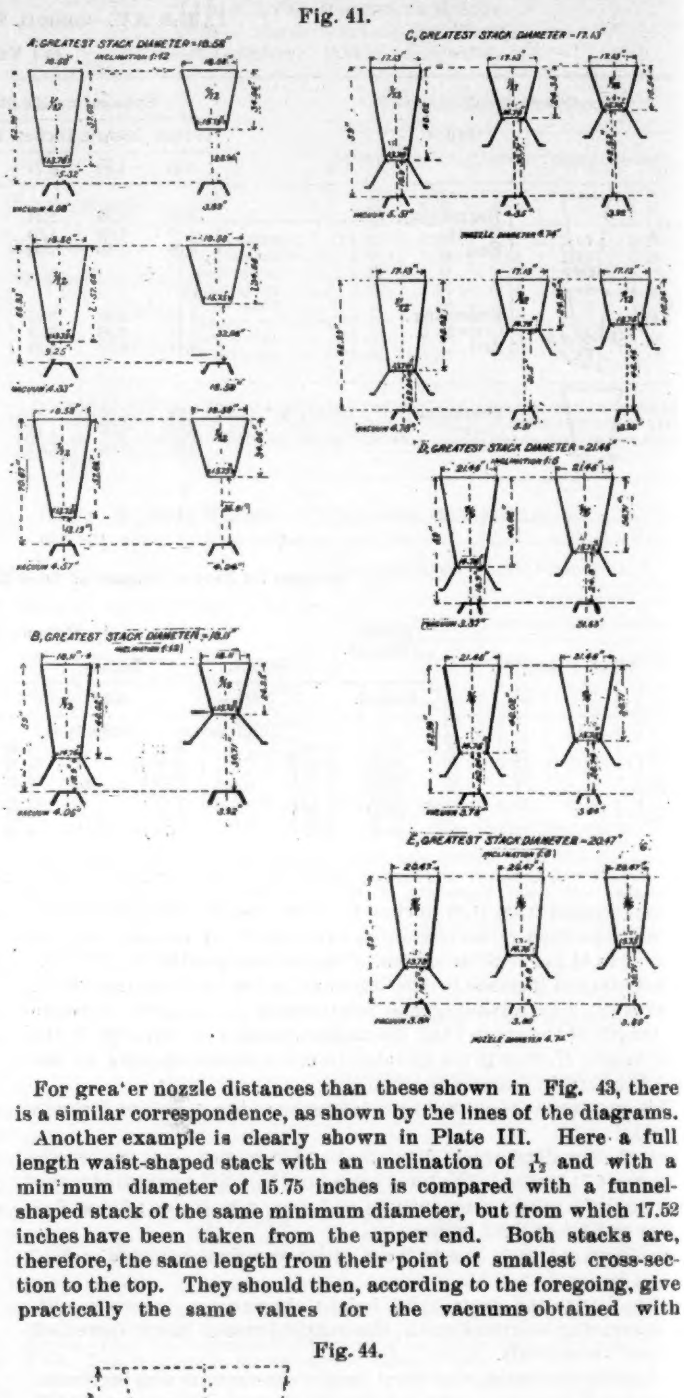
2, between the full length and the stack shortened at the top, wherein the two stacks exactly corresponded at their upper ends, and were of a given length.

Fig. 43 shows two of these stacks having a having a total height of 4 feet 11 inches which for the last 3 feet 4.02 inches of their upper ends are exactly alike. The vacuums obtained with stacks of different diameters and inclinations, with nozzles of 3.94 inches and 4.74 inches in diameter, are shown grouped together in the following table XIX.

TABLE XIX.

				Vacuums with	
				Tunnel-shaped stacks.	Stacks with waist.
	Inches.		Inches.	Inches.	Inches.
Inclination $\frac{1}{6}$	D = 21.42, d = 13.78, d_1 = 14.72	nozzle diameters =	3.94	2.48	2.58
			4.74	3 23	3.37
Inclination $\frac{1}{12}$	D = 17.60, d = 13.78, d_1 = 14.25	nozzle diameters =	3.94	3 39	3.45
			4.74	4.17	4.29
Inclination $\frac{1}{12}$	D = 19.57, d = 15.75, d_1 = 16.22	nozzle diameters =	3.94	2 58	2.60
			4.74	3.27	3.35

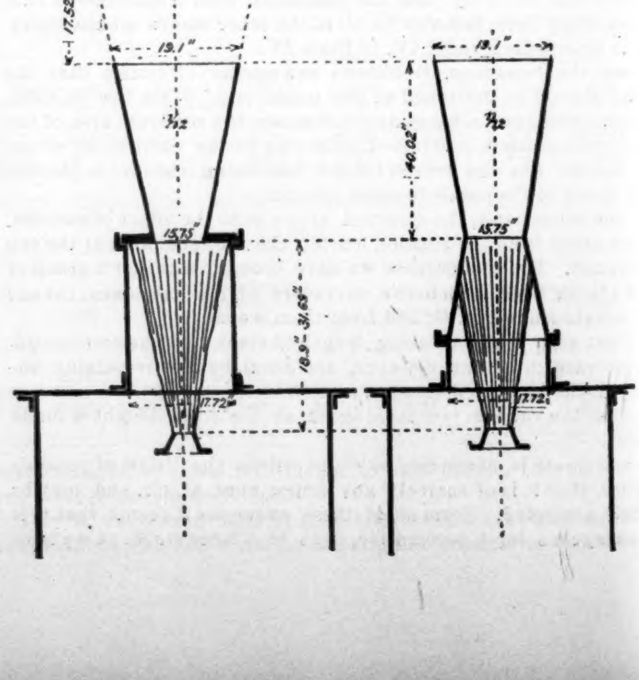
Fig. 41.



For grea'er nozzle distances than these shown in Fig. 43, there is a similar correspondence, as shown by the lines of the diagrams.

Another example is clearly shown in Plate III. Here a full length waist-shaped stack with an inclination of $\frac{1}{12}$ and with a min'mum diameter of 15.75 inches is compared with a funnel-shaped stack of the same minimum diameter, but from which 17.52 inches have been taken from the upper end. Both stacks are, therefore, the same length from their point of smallest cross-section to the top. They should then, according to the foregoing, give practically the same values for the vacuums obtained with

Fig. 44.



them. If we now combine the corresponding co-ordinates of the funnel-shaped stacks from Plate IV. (abscissas 3 feet 0.42 inches to 4 feet 1.19 inches), with those of Plate III. (abscissas 1 foot 6.9 inches to 2 feet 10.65 inches) we obtain as the points of the curve those shown by the dotted curve given in connection therewith.

The latter lie, in all five cases, below each of the waist-stacks, but the actual difference is not really as great as one would be led to think from the diagrams. But we must consider that there were several observations that were known to have been erroneous, that there were many interruptions to the work, and that some slight inaccuracies in the reproduction of the curves have crept in. In figures the values for the abscissa of 18.9 inches with a nozzle diameter of 3.94 inches are, for funnel-shaped stacks, 2.72 inches; for waist shaped stacks 2.82 inches.

When the nozzle diameter is 4.33 inches these values become 3.05 inches and 3.17 inches. When the nozzle distance is about 27½ inches from the smallest portion of the stack, the difference, as shown in Plate III., is greater, though still insignificant. From this it appears to be certain that, with a nozzle distance of about 27½ inches, a continuous current of steam, like that shown in Section VIII., which deals with the "shape of the steam current," begins to fill the whole sectional area of a stack that has a diameter of 15.75 inches, and that, at a greater distance, it strikes against the foot of the stack; that is to say, with the funnel-shaped stacks it strikes directly against the ring at the bottom, while with those having a waist, it impinges against the sides of the flare at the bottom. Both cases are clearly shown in Fig. 44. In the first case there must naturally be a somewhat more vigorous impact and a greater contraction at the smallest cross-section than with the waist-shaped stack, as well as a corresponding f the vacuum indicated.

[TO BE CONTINUED.]

Communications.

The Metric System.

Editor American Engineer, Car Builder and Railroad Journal:

In your April issue, page 59, I find an interesting article on the "metric system." It is true that the larger part of European governments have adopted that system, and in doing so have made progress from the confusion in weights and measures existing in former times. But now that we are intimate with all the peculiarities of the system, we are able to see its various faults, principally arising from the unfortunate choice of units. These units are scientifically derived, but not adapted to the daily work of many people. Their only advantage is in the use of the decadal division, but for the exigencies of practical trade these units are not adapted.

Furthermore, in the metric system only the factors of measure and weight are in good arithmetical connection, while the experience of modern times demonstrates that the factors of *value* and *time* should not stand aside; they are to be fellows of the closed ring—measure, weight, value and time. For all this, though being a condition of progress in the expansion of modern trade, there is no room in the metric system, and, as the world progresses, we see that the metric system is not at all to be the final one. If your country wants to take in hand the heavy work of changing your units for others, these ought to be of a real international character you want a system and units whose practical qualities are much superior to those of any system which has thus far been used anywhere, in order to be accepted for its advantages by other people. This also will be the shortest way to arrive at an international understanding about these things and not by substituting any defective system by another one.

I inclose a short sketch of an international system which might suffice for all scientific and practical purposes. WILHELM BOSSE,
Vienna VII., Burggasse 2, Austria

[Herr Bosse urges, in his circular, that the four factors of dimension, weight, value and time should be based upon some system of the utmost simplicity that is practicable, and should also be connected with one another in a manner that is clear and devoid of complication. In order to accomplish this he starts with his measure of length. In this he would take as the unit the equatorial circumference of the earth and divide it into 1,000 geographical degrees, and then sub-divide each one of these degrees into 10 miles, so that a convenient measure of length would be obtained, and one which could readily be used as a basis of the measure of time. For a practical working dimension this mile should be itself divided into 10,000 feet, two of which feet would be equal to the usual step. Further subdivisions would be on a decimal basis. For cubic capacity, the unit would be a cubic foot, divided into 100 parts. The size of the latter corresponds quite accurately with the ordinary wine measures used all over the world. The unit of weight is also based upon the cubic foot, and should be the weight of a cubic foot of water, and is only slightly heavier than the centner used up to the present time. The subdivisions to follow would naturally be into 100 pounds. For value, Herr Bosse assumes that the relative value of gold and silver to be as 20 to 1. On this basis he proposes an effective weight of $\frac{1}{100}$ pound of $\frac{9}{10}$ fine fine gold, whose value would be about 20 francs as a basis, and on the same hypothesis $\frac{2}{100}$ pound of $\frac{9}{10}$ fine silver would represent two francs. This is recommended as the international unit of value.—EDITOR.]

Discussing Rail Specifications.

At a recent Pittsburg meeting of the officers' association of the Pennsylvania Company, attended by representatives of the lines and branches west of Pittsburgh, the principal topic of discussion was the chemical composition of the steel rails used on the Pennsylvania system. While it was conceded that the character of the rails laid has shown some improvement in recent years, it was also brought out in the discussion that there had been more breakage than the management wanted to see in the past year. The drift of sentiment was toward a specification for lower phosphorus. No formal action was taken, and we are advised by an officer of the road that the matter is simply being investigated with a view to obtaining as much light as possible on the subject. It is not definitely determined, indeed, that any change from recent practice will be made.

The expressions at the Pittsburgh meeting, however, are in line with the new specifications for steel rails presented by Robert W. Hunt at the Atlanta meeting of the American Institute of Mining Engineers last October. Capt. Hunt made the point that whereas the Western mills had been allowed 0.11 per cent. phosphorus in their rails, and in some cases 0.12 per cent., it was now practicable, in view of the vast deposits of low phosphorus Mesabi ores, for these mills to bring the phosphorus in their rails below 0.09 per cent. The new specification which he presented, therefore, called for not to exceed 0.085 per cent. phosphorus, and silicon not below 0.10 per cent. The specified range in carbon was not below 0.43 per cent. and not over 0.51 per cent. for the 70-pound section; not less than 0.45 per cent and not over 0.53 per cent. for the 75-pound section; not less than 0.48 per cent. nor over 0.56 per cent. for the 80-pound section; not less than 0.55 per cent. nor over 0.63 per cent. for the 90-pound section; not less than 0.62 per cent. nor over 0.70 per cent. for the 100-pound section.—*Iron Trade Review.*

The Limit of Elasticity.

In an interesting article in *Science Progress* on the "Mechanical Testing of Iron and Steel," Prof. Hudson Beare has the following to say on the limit of elasticity:

No term has given rise to more confusion in dealing with the strength of materials than this. One instance will suffice to show the kind of error produced by false notions as to its meaning; the well-known fact that by stressing a bar in tension beyond its yield point we raised its limit of elasticity in tension, was usually considered to represent the whole result of the action. We know, however, from the researches of Bauschinger that this is a very imperfect and misleading conclusion—a conclusion, too, which may have caused much of the difficulty in understanding some of the results obtained in the endurance tests of Wohler. Bauschinger's experiments, carried out with perhaps more exactitude than any previous experiments of this nature, lead us to conclude that there is for any given material a true natural limit of elasticity, understanding by that term the limit of the elastic condition according to Hook's law, *ut tensio sic vis.* But this natural limit may be varied in all sorts of ways—by strains set up in the material during manufacture, by after working, or in a testing machine. Unless, therefore, we know the whole previous history of the bar we are testing, we are quite unable to say whether the limit obtained in our test is a natural one, or whether it is some artificial one produced by some treatment the bar has undergone. In one form this fact

was appreciated by all those interested in the question of testing. It was well known, for example, that cold rolling greatly raises the limit. Two bars rolled from the same ingot would give very different values for this factor, the one with the smaller cross-sectional area—and, therefore, during the last stages of manufacture rolled while partially cold—would show a much higher apparent limit. But it was not, at any rate, generally understood that such effects were only particular cases of a much more general law. This fact at once disposes of the talk often indulged in during discussions on this subject as to the value of high elastic limits when they are determined simply from a static tensile test; and the importance of the question is at once realized when we consider that these so-called higher values are made the basis of a claim for higher working stresses, even for cases where the loads are alternating tension and compression. It is to be hoped, therefore, that this question of the determination of the natural limits of elasticity of different qualities of iron and steel will be undertaken as a research work by some competent observers having the requisite delicate measuring apparatus at their disposal. Such a research, if carefully carried through, would settle many important points of the uttermost practical value, and would, at the same time, confirm experiments which, from their far-reaching consequences, and from the fact that the deductions from them depend on extremely small differences in measurements themselves very minute, much need confirmation. Carried out in a systematic manner, careful chemical analysis being made of the material tested, we should obtain data to make it possible to deduce the relations existing between the values of the natural limits, and the proportions of the various constituents of other elements present in iron or steel, and probably be able to ascertain definitely the best proportions for a material required for some given purpose. It would also enable us to settle in a much more rational manner the working stresses which could be allowed in any given case; this, a matter of the utmost consequence in the case of parts of machines or structures subjected to alternations of stresses, is equally of importance where there are only variation of stresses or even only long continued statical loads. for we are still without information as to the changes which may go on in the value of the limit under these conditions. That a steady change in the opinion of engineers in regard to this question of working stress has been in progress for the past few years is undoubted, but at present we are still groping more or less in the dark, because, though there is a mass of rapidly accumulating data, it at present seems largely to be only capable of being used in a more or less empirical fashion, and still to be in need of some rational explanation. The researches of the Committee of the Institution of Mechanical Engineers on "Alloys' has no doubt done something to shift the question into a clearer light, but the field open for research is still very wide.

Kindling Locomotive Fires on the Norfolk & Western Railroad.

At a recent meeting of the Southern & Southwestern Railway Club Mr. R. P. C. Sanderson, of the Norfolk & Western Railroad made the following statement in relation to locomotive fire, kindlers:

It is only recently that much has been heard about kindling fires of locomotives by the use of oils instead of cord wood or waste wood from the car shops, and much mystery and many patents have been in evidence since then.

To ascertain just exactly how much benefit and economy was to be achieved by discarding wood for kindling fires and introducing the use of oil, experimental apparatuses of different kinds were prepared at some of the shops of the Norfolk & Western Railroad, and after a few months of experimental use, with varying success, it was found that the economy by the use of oil as compared with firewood was very great, and pressure was then brought to bear on each of the shops to see how little oil could be used for this purpose.

In the first devices experimented with, crude or fuel oil was employed, as it was thought that the greater calorific properties of crude were decidedly beneficial. As it was a great inconvenience to carry the small quantities of this special oil in stock at points where cheap black oil used for lubricating cars was carried in storage tanks, the use of crude oil or fuel oil was soon abandoned and lubricating oil used, with a small addition of kerosene to make it more inflammable. Subsequently it was found that the addition of kerosene was quite unnecessary and that the lubricating oil was sufficient in itself.

It was then found that by establishing some rivalry between the different shops the quantity of oil used could be steadily reduced until the cost per engine for a month's firing-up had dropped to one and one-fifth cents per engine. Subsequent to this it was further found by one of our master mechanics that the oil was entirely unnecessary, and that by heaping up lump coal in a mound a short distance from the inside of the fire door and by throwing the usual handful of greasy waste (discarded by the wipers) on the face of this coal pile, setting fire to this waste, and then directing a jet of compressed air directly on this small handful of burning waste, the flame from it can be driven right into the coal pile, and that in the course of four or five minutes, or possibly a little longer, according to the condition of the coal and the pressure of the air used, the mound or heap of coal can be brought to a good red heat ready for spreading over the grate bars without the use of any oil whatever. This plan has been found to be successful with the Pocahontas coal, Clinch Valley coals, and Thacker and semi-splint coals used on the Norfolk & Western Railroad, which vary widely in their nature, and it is believed that this same plan can be followed with any coal that is not too hard or slow burning in its composition.

I do not wish to say that we do not now use any oil for firing up, because we have found that with the use of a little oil in with the compressed air, it will hurry up matters a little in cases of emergency.

The majority of the engines fired which are referred to have large fireboxes 10 feet or more in length, and at most of the engine houses the boilers are filled with hot water, and in this way considerable economy in time in firing up and getting engines ready for service has been accomplished without any injury to the boilers.

Where nothing but air is used to ignite the coal, it will be found ordinarily that it does not pay to handle the scrap wood from the car repair tracks or the old ties or bridge lumber, as the cost of cutting it up and handling it is greater than the small amount of coal consumed in compressing the air, and to get rid of this old material it is found to be more economical to sell it as firewood to the employees and public at a small price, or to burn it up in heaps where it lies, if it cannot be got rid of in any other way.

We take from the discussion of Mr. Sanderson's statement the following:

Mr. Gentry—Mr. Sanderson does not say how much coal is used. I don't suppose much of it is consumed. I take it that it don't take very much more coal than where wood is used. I saw one experiment made at Alexandria by Mr. C. F. Thomas, and it didn't strike me that very much coal was consumed during the process of ignition.

Mr. Hudson—My experience has been that it takes very little more coal to kindle with oil and coal than it does with wood and coal. I find that fires can be kindled with a great deal of economy without using any oil at all by simply putting in a small quantity of waste, and using the steam blower on the engine. We fire about as many engines without oil as with oil, and there is no injury to the flues or sheets. There is practically no difference in time with or without oil.

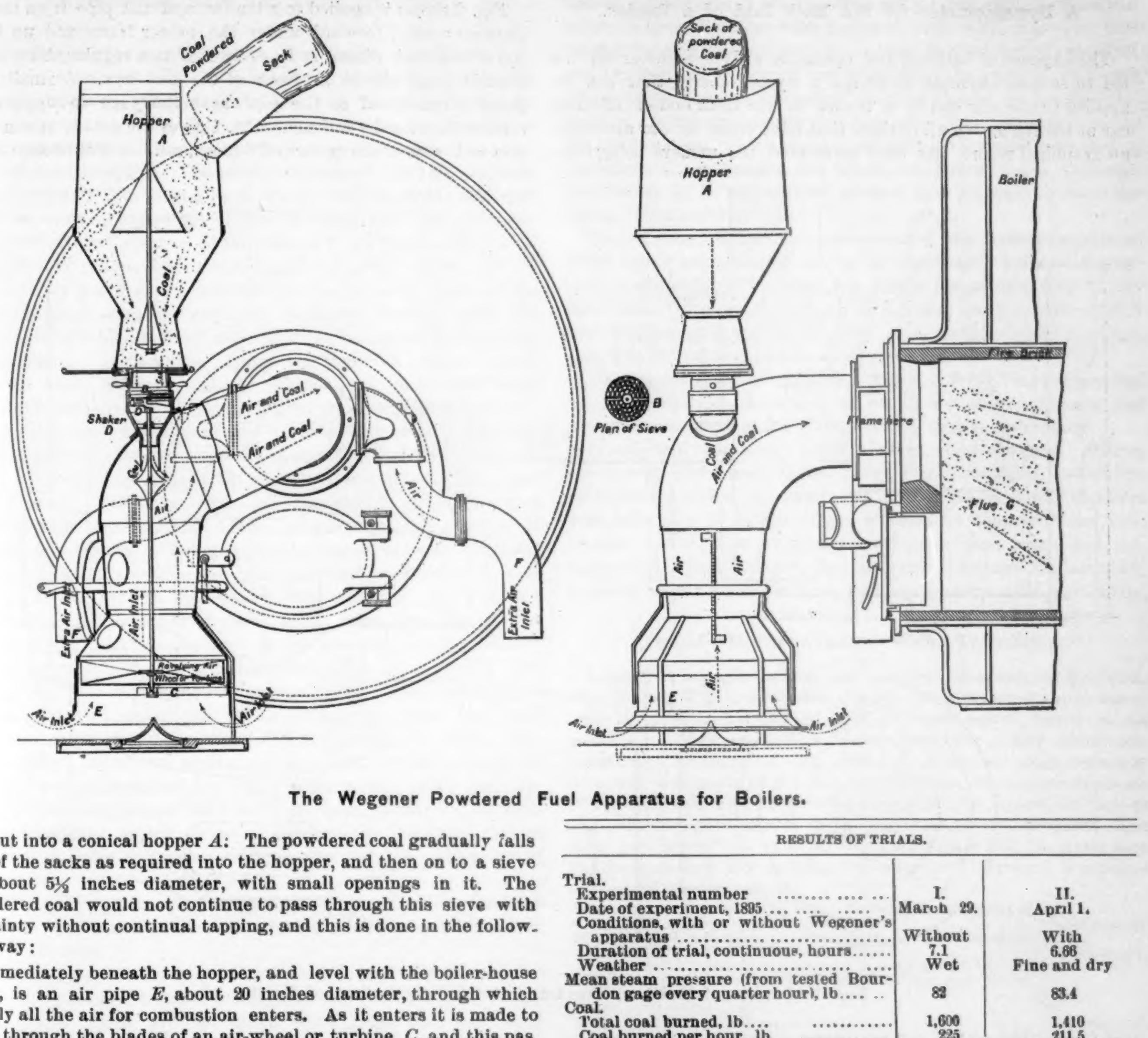
T. W. Gentry—It was not necessary for the parties I referred to to go to any expense in the way of a new plant. They utilized what they had at hand, which was an old boiler, to fill the engines with hot water. Anybody who has an air pump can utilize it. It is not much of an item with a few engines. The experiment I have seen was in a large engine house, where everything was at hand. They just used the blower and the dirty waste.

Mr. Anderson—I remember making one experiment in kindling fires with dirty waste, in which it took within a few pounds of 500 pounds of coal to get 65 or 70 pounds of steam. I did not use any wood, and we got steam up in about 55 minutes. I have not used any wood for over two years; we kindle all our fires with waste that has been used to wipe with.

Wegener's Apparatus for Burning Powdered Fuel.

The accompanying engraving, reproduced from the *Engineer*, illustrate a new form of apparatus designed by Herr Wegener for burning finely pulverized coal, and burning it in such a way that the quantity is automatically varied with the quantity of air admitted for supporting combustion. The apparatus has been in use some time in Europe, and is now in use in the works of Messrs. Bryan Donkin and Co., London, England.

Our engraving shows the apparatus in detail as applicable to any boiler. The small sacks of powdered coal, weighing about 50 pounds



The Wegener Powdered Fuel Apparatus for Boilers.

are put into a conical hopper A: The powdered coal gradually falls out of the sacks as required into the hopper, and then on to a sieve B, about 5½ inches diameter, with small openings in it. The powdered coal would not continue to pass through this sieve with certainty without continual tapping, and this is done in the following way:

Immediately beneath the hopper, and level with the boiler-house floor, is an air pipe E, about 20 inches diameter, through which nearly all the air for combustion enters. As it enters it is made to pass through the blades of an air-wheel or turbine C, and this passage of the air causes the latter to revolve like a smoke-jack. On the axis of this air-wheel there is a little knocker which taps the sieve from 150 to 250 times per minute, causing the powdered coal to descend vertically through the sieve, meeting the air for combustion as it ascends vertically. The powdered coal and air for proper combustion in this way get mixed thoroughly together and pass on into the boiler flue, each particle of coal being surrounded by air. There is no grate and there are no fire doors, and the stoking simply consists of putting a sack of powdered coal from time to time into the top of the hopper, and seeing that the right amount of air is going in for combustion. If there is not sufficient air for proper combustion entering through the main opening, as shown by a little smoke, there are two other smaller pipes where additional air can be admitted, each kind of coal requiring a somewhat different amount of air. The only object of the air-wheel revolving from 75 to 125 revolutions per minute is to shake the sieve and cause the powdered fuel to go into the furnace in the quantity desired. When more steam and coal are required a greater knock is given to the sieve, and more powdered coal is burned; when less is required a less shake is necessary. A screw adjustment for this knocking device is provided to regulate the amount of coal entering, which is done by turning a thumb-screw. The attendant can look after several boilers. An analysis of gases of combustion proves that the combustion is excellent and the amount CO_2 is higher than with ordinary furnaces.

Mr. Bryan Donkin made a careful test on a Cornish boiler, at Berlin, in March last, first, with an ordinary grate and ordinary hand-stoking; and, secondly, a few days after, on same boiler, same conditions, and same coal, but with Wegener's patent system of powdered or molecular firing.

The following table gives the results of the experiments:

RESULTS OF TRIALS.

Trial.		
Experimental number	I.	II.
Date of experiment, 1895	March 29.	April 1.
Conditions, with or without Wegener's apparatus	Without	With
Duration of trial, continuous, hours	7.1	6.66
Weather	Wet	Fine and dry
Mean steam pressure (from tested Bourdon gage every quarter hour), lb	82	83.4
Coal.		
Total coal burned, lb	1,600	1,410
Coal burned per hour, lb	225	211.5
Coal burned per hour per sq. ft. of fire-grate, lb	16.3	....
Moisture in coal, per cent	9.0	1.2
Ashes and clinkers in coal, per cent	14.8	Assumed at 15 to 19
Water.		
Mean temperature of feed water entering Boiler, Fah	63°	48.2°
Total feed water evaporated, lb	7,928	10,517
Water evaporated per hour, lb	1,117	1,577
Water evaporated per hour per sq. ft. heating surface, lb	2.23	3.15
Evaporation.		
Lb. water evaporated per lb. wet coal, from temperature of feed, lb	4.956	7.46
Lb. water evaporated per lb. wet coal, from and at 212 deg. Fah., lb	5.90	9.00
Lb. water evaporated per lb. dry coal, from and at 212 deg. Fah., lb	6.48	9.11
Caloric value of coal, lb. water per lb. dry coal, from and at 212 deg. Fah., lb	12.0)	11.85
Thermal efficiency of boiler = $\frac{\text{actual evaporation}}{\text{caloric value}}$, per cent	54	77
Chimney and gases.		
Mean position of damper	Full open	Full open
Temperature of furnace gases at end of boiler tube, Fah	above 750°	above 750°
Temperature of furnace gases at base of chimney, Fah	438°	413°
Draft of chimney in side flue at front of boiler, inches of water	0.41 in.	Water gage oscillated from a slight pressure to a vacuum.
Draught of chimney at base of chimney, inches of water	0.61 in.	
Mean analysis of furnace gases, taken every quarter hour: CO_2 p. c. by vol.	8.73	15.35
O " "	8.13	3.14
CO " "	0.88	0.0
Temperature of air in boiler house, Fah	54°	58°
Smoke.		
Total number of times smoke observed	70	7
Total duration of smoke, minutes	105	6
Mean intensity of smoke (Mr. D. K. Clark's smoke scale), number	7	5

In this experiment the bars were rather too wide apart for the small coal used to get the best results.

A Dynamometer for the Back End of a Tender.

The expense of building and operating a dynamometer car has led to several attempts to design a dynamometer that can be applied to the rear end of a tender or the front end of the first car of the train. In all of these that have come to our attention no graphical record has been attempted, the makers being content to read the pull, speed, etc., from gages. On the Northern Pacific Railroad an endeavor was recently made to provide an inexpensive and reliable dynamometer, and the details of the resulting apparatus are shown in the accompanying engravings. It was designed and patented by Mr. McHenry, one of the receivers of the road.

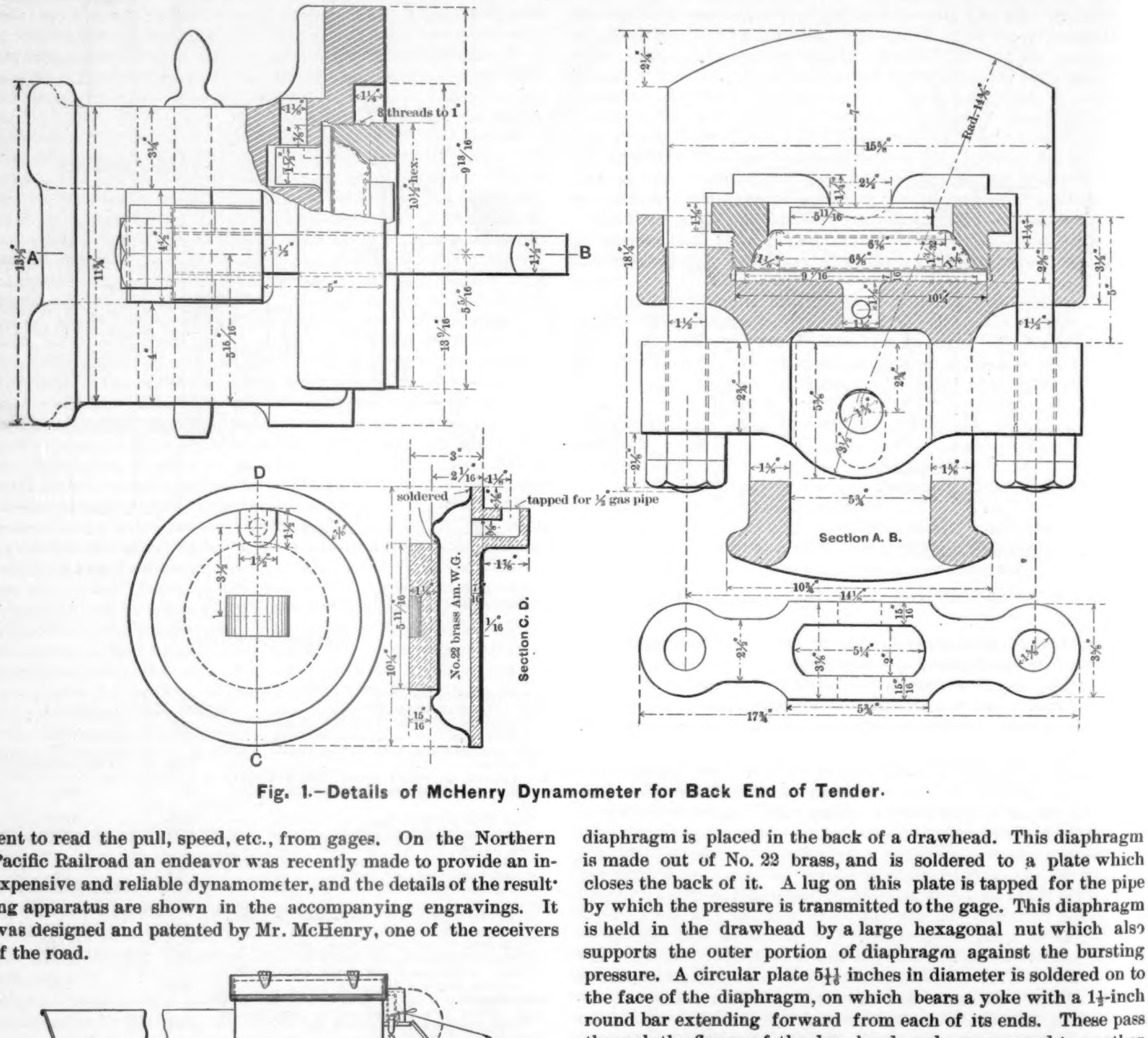


Fig. 1.–Details of McHenry Dynamometer for Back End of Tender.

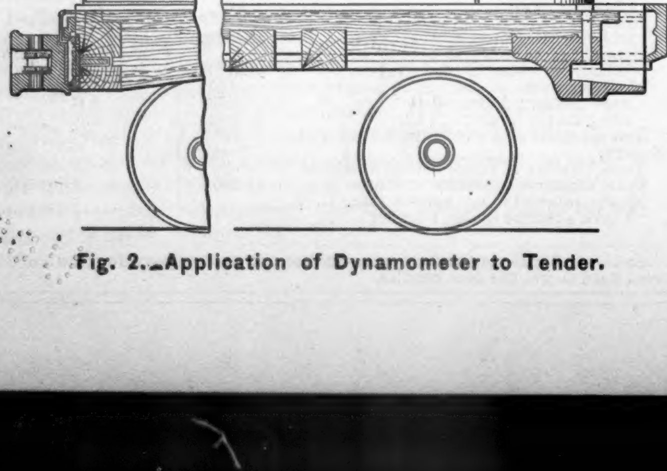


Fig. 2.–Application of Dynamometer to Tender.

Fig. 2 shows it applied to a tender and the pipe from the diaphragm carried forward under the tender frame and up to the top of the tank where it is connected to a regular steam or hydraulic gage placed in front of the tool box. A small force pump is connected to the pipe near the gage to supply oil to replace that lost by leakage. Fig. 1 gives the details of construction and most of the principal dimensions. It will be seen that a diaphragm is placed in the back of a drawhead. This diaphragm is made out of No. 22 brass, and is soldered to a plate which closes the back of it. A lug on this plate is tapped for the pipe by which the pressure is transmitted to the gage. This diaphragm is held in the drawhead by a large hexagonal nut which also supports the outer portion of diaphragm against the bursting pressure. A circular plate 5$\frac{11}{16}$ inches in diameter is soldered on to the face of the diaphragm, on which bears a yoke with a 1½-inch round bar extending forward from each of its ends. These pass through the flange of the drawhead and are secured to another yoke by means of two nuts on each. This second yoke passes transversely through the drawhead and at its center is provided with a slot and pinhole by which an ordinary link and pin can be coupled to it. The whole arrangement is so simple that it will be readily understood.

We have described the dynamometer as applied to a tender, but we learn that though designed for that place it was as a matter of fact attached to a caboose that was run next to the engine. As far as we have been able to learn the only serious trouble experienced in the use of the device was occasioned by the rupture of the diaphragm. This we should think could be overcome by making the unsupported area of the diaphragm considerably less than shown in the drawings. From such investigations as we have been able to make into the requirements for such apparatus we are inclined to think an initial tension on the diaphragm is desirable, but it may not be essential. The apparatus illustrated is certainly one of the most compact that has been constructed for the line of work mentioned.

Crosby Steam Gage and Valve Company.

This company, as most of our readers know, is a Boston "institution," with its works in Charlestown, of Bunker Hill fame. Recently while enjoying a visit to the Hub the pleasure was increased by an inspection of the works referred to, the expedition being personally conducted by Mr. George H. Eager, the treasurer of the company. The works consist of a main building 451×77 ft. and four stories high, which is thoroughly equipped with the most approved machinery for manufacturing the appliances which are specialties of the company. As its name indicates, the principal products are steam-gages and safety-valves. Of the former they make several different kinds. Among these are the Bourden gage, with an ordinary C-shaped pressure tube, the lower end of which is fixed and the upper connected to the index mechanism. In another form the tube is placed thus, ◡, and held securely in the middle, the two ends being free and attached to a T-shaped lever which operates the index. With these gages a system is used to keep the gage tube filled with water and thus keep it cool. A third form is what they call their "thermostatic water back gage," in which two tubes are placed thus ( ) with their lower ends attached to a chamber which is filled with water or other liquid, and answers the purpose of an ordinary siphon. This chamber is placed between the two tubes. The upper ends of the tubes are connected to a T lever which forms part of the index mechanicism. It is found however, in practice that after the tubes have been tested and adjusted to a certain movement under pressure in the ordinary temperature, and then give correct indication of pressure, that when the tubes are heated in use to a higher temperature they are lengthened thereby to such an extent that their free ends will then move through a larger arc than they did when they were tested, and thus a greater pressure than actually exists in the boiler is indicated on the dial. In the gage which is here described, the long arm of the T lever is made of brass and steel brazed together, which forms a "thermal bar," and the unequal expansion of the two metals compensates for the expansion of the tubes.

These gages, the makers say, are especially adapted for locomotives and for other boilers in which the high pressures now in vogue are used.

The company makes gages for a great variety of purposes, including hydraulic, vacuum water, ammonia, air, gas and pyrometer gages. These are all tested with great care and with apparatus specially constructed for the purpose, with which the testing-room is equipped. The utmost care is exercised, and the greatest precision is aimed at, in testing gages, and any defect is certain to be detected before they leave the company's hands.

Another important branch of the Crosby Company is the manufacture of safety valves. These are of the "pop" type, and are made especially for locomotives. A peculiarity is a flat annular seat, which the company claim can be kept tight easier and longer than any other form. The valves are encased and some types are provided with perforated mufflers to deaden the noise. What is called the Meady valve and the Crosby-Meady valve is made for locomotive and also stationary and marine boilers. A variety of forms and patterns are made adapted to various classes of boilers.

One of the phenomena of modern engineering is the greatly increased use of indicators, as a means of diagnosing the condition and operation of the organs of steam engines. Their use has been greatly extended, no doubt, by the general diffusion of technical education. The result has been that of late years there has been a great demand for reliable indicators, and supplying these has become an important branch of the Crosby Company's business. The introduction of high-speed engines of late years has created a special demand for improved indicators, which the Crosby Company have made great efforts to supply. The greatly increased speed of steam engines has made extreme lightness, a nice adjustment of moving parts and the finest workmanship indispensable in an indicator to make it reliable. To meet these requirements the utmost refinements of good workmanship are essential. The Crosby shops have therefore been equipped with with the very best machinery and appliances to make these instruments of precision, and an elaborate system of manufacturing the parts in duplicate and to gages has been organized, so as to insure the required accuracy. When the instruments are assembled they then go to the testing-room, which is equipped with a very elaborate testing apparatus for subjecting the whole mechanism to a thorough trial before it is pronounced perfect and allowed to leave the hands of the makers.

The construction and the operation of the testing apparatus could not be axplained so as to be understood without illustrations, and for them we have not space, nor is there time to prepare them. It must suffice now to say that every indicator made here is thoroughly tested in every way, so as to make it certain that it is entirely reliable in all respects.

The company also manufacture Amsler's Polar Planimeter, that mechanical puzzle, the action of which few of us old chaps, and probably not many of the younger ones, clearly understand.

Locomotive counters, relief valves, pressure-gage testers, spring-seat globe and angle valves, steam whistles, bell-chime whistles—of which we saw some specimens for Sound steamers with bells 12 × 24 inches—organ whistles for steam launches, etc.; whistle valves, blow-off valves, water-gage glass tubes and columns, water-gage fixtures, etc., etc., are all articles that are made in these works, which are so well equipped in all departments.

Test of a Combine Safety Water Tube Boiler.

A test was recently made of one of these boilers at the Marietta, Pa., Electric Light, Heat and Power Company's station to determine its capacity. It was rated at 125 horse-power, based on an evaporation of 30 pounds of water per hour from a feed water temperature of 100 degrees F. into steam at 70 pounds gage pressure. The test was made by Mr. Jay M. Whitham, Mechanical Engineer of Philadelphia, with the co-operation of Mr. W. Barnet Le Van as the representative of the light, heat and power company. The total heating surface of boiler was 1,100 square feet, the grate area 21,875 square feet. The test was continued for 8 hours and 39 minutes with the following results:

Water evaporated from and at 212 degrees F. per pound of dry coal	9.346 pounds.
Water evaporated from and at 212 degrees F. per pound of combustible	10.52 pounds.
Average boiler horse-power actually developed, by basis of 30 pounds per hour from 100 degrees F. at 70 pounds pressure	161.4
Rated boiler horse-power	125
Horse-power developed above rating	29.1 per cent.
Pounds of dry coal burned per hour per boiler horse-power developed	3.69
Pounds of wet coal burned per hour per boilerhorse-power developed	3.76

A Locomotive-Building Plant for Russia.

A firm of American capitalists, to be known as the Russian-American Manufacturing Company, has been incorporated, with headquarters at present in Philadelphia, for the purpose of establishing extensive locomotive works at Nijni-Novgorod, Russia. The firm of Edmund Smith & Company, of Philadelphia, are interested in the project and Mr. W. F. Dixon, formerly of the Rogers Locomotive Works, has visited Russia to look over the site and prepare plans for the shops. The plant is to have a capacity of 200 locomotives per year and contracts for $500,000 of machinery have already been placed with American tool builders. Among those who have received large orders are Bement, Miles & Company, Wm. Sellers & Company, Newton Machine Tool Works and Pedrick & Ayer Company, all of Philadelphia; Hilles & Jones and Betts Machine Company, Wilmington, Del.; the Niles Tool Works, Hamilton, O.; the Morgan Engineering Company, Alliance, O., and Greenlee Bros., Chicago.

The plant is to be built in connection with the Sermova Works, an extensive establishment in Nijni-Novgorod, manufacturing cars, steamboats, steam boilers, etc., and employing 5,000 men. Mr. Dixon will have entire charge of the locomotive works, which will be controlled jointly by the Russian and American companies. The locomotive plant will employ 1,000 men. It is understood that the Czar has encouraged the enterprise.

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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CONTENTS.

The great amount of space required to properly report the proceedings of the conventions held in June has excluded from our pages this month much valuable material, among other articles laid over being the second one of the series on the Altoona shops of the Pennsylvania Railroad. This will appear next month.

The topical discussions introduced at the convention of the Master Car Builders' Convention last month were a great success. By having each subject introduced by members who had prepared brief and concise arguments or statements, the discussions were immediately directed upon the essentials of the topic, with the result that the 10 minutes allotted to each subject was usually sufficient to bring out all valuable information in the possession of the members. Preparation of that kind is the secret of topical discussion, and it is probable that the lack of that preparation has had its effect in almost wholly banishing topical discussions from the meetings of the Master Mechanics. The great number of reports presented and the time required for their consideration have also had their effect in eliminating these discussions from the latter body.

The new interchange has won and has received the unanimous approval of the Master Car Builders. No voting by cars was requred this year; on the contrary, there was not only an overwhelming sentiment in favor of the new interchange, but an evident desire on the part of the convention to take the entire new code as it came from the Arbitration Committee without discussion or change. Such faith in the committee and its work is justifiable, and we are inclined to think that a similar treatment of its reports each year would not only save much time for the convention, but would result in a better and more consistant code. The changes made on the floor of the convention are apt to be found contradictory or inconsistent with other paragraphs from the simple fact that one cannot at such times keep in mind all the various sections of the code.

By the decision of Judge Coxe, of the Circuit Court of the Northern District of New York, in the suit of the Gould Coupler Company against Pratt & Letchworth, rendered last November, it was decided that any knuckle-opening device that both automatically opened a knuckle and held it open was an infringement on the Browning patent owned by the Gould Coupler Company. If a device performs either one of these functions and not both it is not an infringement. A decision on an appeal from a preliminary injunction by Judge Lacombe, of the United States Circuit Court of Appeals, rendered May 27, defines the limitations of the term automatic, and decides that a device which does not act independently of the will of the operator and without his aid when the lock is raised, but on the other hand requires a distinct and separate movement on the part of the operator to swing the knuckle open, is not automatic, and is not covered by that term in the claim of the Browning patent. The case appears to be far from being settled, however, as the Gould Coupler Company announce that they will proceed with the case as though no injunction had been asked for.

In a discussion on the pooling of engines at the April meeting of the Western Railway Club, an apparent diversity of opinion existed. We say apparent, for on close reading it seems that members had different definitions of pooling in mind during the discussion. If pooling be taken to mean that method of running engines in which no crew or sets of crews are assigned to any one engine, and no crew is responsible for an engine, then it may be said that there were few friends of pooling present. At the same time it is realized that the highest standards of operation require that engines shall make a large monthly mileage—much larger than can ordinarily be obtained by assigning a single crew to each engine. Hence the practice of assigning two crews to one engine, three to two, five to three, or in a similar way grouping engines and men into what has been called "small pools," instead of one general pool, is gaining in favor, and, we think, rightly so. Pooling, in the broad sense of that term, has generally been found to lead to increased cost of

repairs and of fuel, due partly to the lack of interest on the part of the men in the engines they run, and partly through the lack of that familiarity with an engine and its peculiarities which is obtained by long association with it. By so assigning the crews to engines that the motive power will be kept in motion as much of the time as is compatible with proper care and maintenance, and each engine has at least one crew that is responsible for its condition, the large mileage can usually be obtained without the disadvantages associated with a general pool. But lengths of divisions, character of traffic and other local conditions must be taken into account in the decision of any individual case.

Those who believe that the formation of dense smoke in steam plants can be abated and the smoke nuisance in our cities and towns greatly reduced, and who at the same time believe that the formation of smoke cannot be wholly prevented without a loss in the efficiency of the boilers, will doubtless find support for their views in the results of a peculiar competitive test recently carried out under the auspices of the Sheffield Smoke Abatement Society. Five competing firemen were each allowed to fire a Lancashire boiler for seven consecutive hours and the prize was awarded to fireman who evaporated the greatest quantity of water with the least amount of fuel and with the least quantity of smoke. The boiler was 28 feet long and 8 feet in diameter, the two flues being 3 feet 3 inches in diameter at the front, tapering down to 2 feet 10 inches at the back. The grates measured 6 feet by 3 feet 3 inches, giving a total grate area of 39 square feet. The grate bars had $\frac{1}{4}$-inch spaces. The working pressure was 100 pounds per square inch. The coal used was "washed hard nut" and was of uniform size and very clean. The best result as to evaporation was equivalent to 9.03 pounds of water from and at 212 degrees Fahr. per pound of coal, but the fireman with this record had, on the other hand, the worst showing as to smoke. The first prize went to a fireman who secured an equivalent evaporation of 7.95 pounds of steam from and at 212 degrees Fahr., while only producing dense smoke for six minutes out of the whole seven hours occupied by the trial. This record was beaten by two other competitors, one of whom produced dense smoke for two minutes only and was reponsible for an equivalent evaporation of 8.07 pounds per pound of coal, but he produced much more "faint" and medium smoke than the first prize winner, and so failed to head the list. The coal burnt per square foot of grate surface per hour ranged from 23 pounds to 28.1 pounds. Thus we see that the man who produced the least smoke was beaten by three out of four of his competitors on evaporation. While this may go to show that an entire absence of smoke from the average boiler may mean a loss in efficiency, it must be borne in mind that all of the men produced amounts of smoke infinitesimal in comparison with the average fireman of to-day, and that the production of more than formed in the worst of the five trials would have doubtless been accompanied by a falling off in the evaporation. No argument can therefore be drawn against the improvement in the average of present practice so urgently needed.

The problem of providing competent and skillful workmen in the various departments of manufacturing establishments and railroad shops is one that is not easily solved. It is believed, however, that the committee which reported on the subject to the Master Mechanics' Association last month went wide of the mark. We do not intend to take up the matter at any length, at this time, but we would submit for consideration the opinion that the most important part of the problem lies not so much in the opportunity to be given the technical graduate, or the technical education of the apprentice, important as these are, but rather in the shop training of those who by their talents or inclinations are destined to remain in the shop either as workmen or foremen. The technical graduate will generally find means to get as much shop training as he needs, and as he usually has ambitions and a well-defined purpose, his case is a special one capable of special treatment. The well-educated apprentice who is bound to make his trade a stepping-stone to something higher is undoubtedly deserving of encouragement and any help and counsel given him in the shop or out of it will prove a good investment for the individual or firm that tenders it. Nevertheless, the great class demanding consideration on the part of employers we believe to be the average apprentice who intends to remain in the shop and who will end his apprenticeship according to the treatment he receives, either as a skillful and intelligent workman, loyal, independent and manly, and of great value to his employers, or as a mechanic capable of doing few things well, perceiving more or less clearly the injustice of the treatment accorded him, and ready to join the ranks of those who wage the war between capital and labor. The improvement in the training of this class of apprentices, if their presence in the shops is to be continued, must begin with the shop training itself, before it takes up their technical education. It is their right. They go into the shop to work for a certain number of years for a compensation which is to be paid partly in cash but mostly in knowledge. If the opportunity of acquiring the latter has been denied them, they have not been fully paid, even if the cash part of the pay has been forthcoming regularly. And if the employer who keeps a boy on a bolt-cutter or a drill-press or doing the lower grades of work about a shop, until most of his time has been spent, considers he is just in his treatment of the boy, or has put money in his own pocket, he is mistaken. He has not only been unfair to the apprentice, but he has actually failed to benefit by his services as much as he might. This class of apprentices who learn a trade and work at it for life, are the most numerous class, and employers are interested in improving their facilities and opportunities for acquiring knowledge.

REDUCED LEAD FOR LOCOMOTIVES.

The mechanical officials of a number of large railroads in the West have recently given much attention to the effect of various amounts of lead upon the steam distribution and economical performance of locomotives. The time-honored rule in valve-setting in many parts of the country has been to give the engine $\frac{1}{32}$ or $\frac{1}{16}$ lead in full gear, and trust to luck for good results in the working cut-off. With some valve gears this method of setting gives a lead of about one-quarter inch in the six-inch cut-off, while with others it may give as much as three-eighths of an inch. The latter condition is almost certain to produce a bad riding engine—one that is uncomfortable for the men and hard on its machinery, besides being less efficient.

The few who have had the hardihood to disregard that aged and much respected rule by which a given amount of lead is carefully provided at full stroke where it is of no account, and allowed to be settled by mere chance at cut-offs where it plays an important part in the working of the engine, have adopted various methods of obtaining a desirable lead at the cut-offs where the engine does most of its work. One of these methods is to set the valves blind in full gear by an amount sufficient to give the proper lead at the working cut-off. This sometimes results in the valves being nearly one-quarter inch blind in full gear to get, say, three-sixteenths lead at six inch cut-off. Contrary to what some persons would expect, a passenger engine with the valves so set will work admirably. Another method for accomplishing the same result is to set the valves about line and line in full gear forward and to move the backing-up eccentrics until the lead at the working cut-off is reduced to the desired figure. This method is all right for a passenger engine, but may not be desirable on a freight engine that is called upon to back heavy trains. Evidently a combination of the two methods mentioned might also be employed. Each of the methods has had its advocates, but the experience of the roads referred to teaches two lessons most clearly: First, that the lead on fast passenger engines, whose valves are set with lead in full gear for forward and backward motion, is too great in early cut-offs; and, second, that it makes comparatively little difference in the working of a road engine how the reduction of lead is effected, providing, of course, that the valves are not set in a manner that will place the engine at a disadvantage in occasional switching operations or other special duties. The essential condition seems to be that the lead should be just sufficient to

admit the right amount of steam to obtain boiler pressure in the cylinder at the end of the stroke under the average conditions of speed and cut-off. To provide more lead than this is to produce a loop on the diagram, an undue strain on the running gear, greater friction in the engine when passing the dead centers, a poorer steam admission line with its consequent loss of power, and a bad riding engine. Having determined the right amount of lead to overcome these troubles, experience shows that there is but little choice between the methods of obtaining it, as the advantages which any one method may appear to have in delaying the exhaust opening or closure, or affecting other points in the steam distribution, are small compared with the gain from proper lead.

The gain in power from the reduction of the lead is remarkable. It has been found to make passenger engines smart and capable of making up time with trains that under the old method of setting they could hardly haul on schedule time, and has enabled freight engines to handle satisfactorily ten per cent. heavier trains. It is needless to add that where Allen valves are used the lead should be cut down to an amount sufficient to produce exactly the same influx of steam at the end of the stroke as with the plain valve. This done, the greatest advantage of the Allen valve will be realized. This seems to be the gist of the matter and the conclusions certainly appeal to the sound sense of those who are familiar with the problems associated with the proper distribution of steam in locomotives.

COUNTERBALANCING LOCOMOTIVES.

The report on counterbalancing locomotives presented to the Master Mechanics' Association last month is the best contribution to the subject that has appeared for a long time. It is brief and to the point, and the committee in recommending that the weight of reciprocating parts left unbalanced should bear a definite ratio to the total weight of the engine rather than to the weight of the reciprocating parts themselves, undoubtedly formulated the only correct rule. Experience may show that the ratio should vary somewhat with the length of the engines, the wheel bases and the weight on the forward trucks, but the principle on which the rule is based will stand.

The discussion of the report brought out the vicious character of some of the methods of counterbalancing at present in vogue. The worst of these is that of the unequal distribution among the drivers of the counterbalance for the reciprocating parts Sometimes this is done so that the same wheel pattern can be used in eight-wheeled engines, and in consolidation, mogul or ten-wheeled engines, it is often done because it is impossible to put the proper amount of counterbalance in the main wheels. Now, the old rules of balancing from 60 to 90 or even 100 per cent. of the reciprocating parts and equally distributing that balance among the drivers is not as scientifically correct as the rule proposed by the committee, but we venture the assertion that no case of bent rails or other damage to track ever occurred where such a rule was followed. The damage to track has always resulted from a shortage of counterbalance in one pair of wheels being made up by an excess in others. There is no excuse for such bad practices. In eight-wheeled engines it is always possible to put the correct amount of counterweight in each wheel and the same is true of mogul and ten-wheeled engines whose drivers are large enough for fast service.

In freight engines of these or the consolidation types, it may be impossible to get the required amount in the main wheels, but it is much better practice to let the total amount of counterbalance for the reciprocating parts fall short of the amount required by rule than to make up the shortage by placing excessive weights on the other wheels. It is true that a small amount of the shortage might be thus made up with safety in some cases, but the practice is a dangerous one unless the assignment of the weights to the various wheels is made by one familiar with the whole problem. The rule proposed by the committee will tend to correct this evil, as freight engines of the types mentioned are usually quite heavy, and a larger portion of the reciprocating parts can be left unbalanced, thus making it possible in practice to get nearer to the total counterbalance required in the main wheels. But master mechanics will still meet with special cases, and then the caution to be heeded, if one would prevent damage to track, is to avoid an excess of counterweight in any one pair of wheels.

THE CONVENTIONS.

The Car Builders' and Master Mechanics' annual conventions have now become established "institutions" in this country and those who are connected directly and indirectly with the two departments of railroad operation, which are represented at those meetings, would feel that the year would be as incomplete without them as it would be if Fourth of July and Christmas were omitted. The attendance this year was larger than ever, and it may readily be understood that those who have been coming to these meetings for five, ten, twenty or twenty-five years have made many pleasant acquaintances in that time, and that the annual assemblages have not only their technical and professional interest, but that they are social reunions, around which many pleasant reminiscences cling, and which recall some sad recollections. The people who go there have, of course, changed very much during the period that has intervened since the associations were first organized. Some of us who have been in attendance for a quarter of a century are compelled to admit

"That we, we are the old men now;
Our blood is faint and chill;
We cannot leap the mighty brook,
Or climb the breakneck hill.
We maunder down the shortest cuts;
We rest on stick or stile,
And the young men, half ashamed to laugh,
Yet pass us with a smile."

Some one has said that "young men think old men are fools, but old men know young men to be so." The Germans have a maxim that the "old effect more by counsel than the young by action," and another proverb is to the effect that "experience without learning is better than learning without experience," and Dr. Johnson said that "experience is the great test of truth, and is perpetually contradicting the theories of men." Nevertheless it must be admitted, in the words of an Eastern adage, that "a prudent youth is superior to a stupid old man," and taken all together that the young chaps have the best of us.

These reflections are suggested somewhat by the character of the proceedings of the meetings. A comparison of the reports presented in Saratoga with those made, say, 10 or 20 years ago, will indicate that a new element has been introduced into the association. That element is the graduate of the technical school. He has now assumed control and is likely to keep it. It has been said of youth that it is a defect which cures itself, and the same is true of the inexperience with which the graduates of technical schools were charged not long ago. If they are appointed and remain in responsible places, they are certain to get experience, and will thus be obliged to submit themselves to the contradictory teaching which Dr. Johnson referred to. In view of this, the old chaps can temporarily tolerate such crudities as may sometimes float on the surface, knowing full well, that the authors of them will in time learn, what some of us have found out by hard knocks, which is that those things which are not quite sure are very uncertain.

There are two considerations which should never be lost sight of by committees in preparing reports for these associations. One of these is that the majority of the members are and probably always will be men whose schooling has been in the shop, and who are erudite in experience, but not in scientific knowledge, and who are more skillful in the use of mechanics' tools than in mathematical formulæ. As this class forms the majority of the the members they should not be ignored, as they are when reports contain much matter which is incomprehensible to the practicians. A report should be adapted to its purpose, and at least part of it should be understandable by those to whom it is read and for whose edification it is intended.

The other part which is often lost sight of by the authors of reports is the limited time and attention which can be given to them. The Car Builders hold two sessions of three hours each for three

successive days, and the Master Mechanics one session of five hours, so that at most they are only in session from fifteen to eighteen hours, a considerable portion of which time is devoted to routine business. The Master Mechanics this year had reports on ten different subjects, and the Master Car Builders on twelve. It is, therefore, almost impossible to devote an average of as much as an hour to the reading and discussion of each of the reports.

Then, too, there is the fact so seldom realized that it is extremely difficult to keep the attention of an audience on anything which is read for more than 20 minutes, and to do that it must be interesting and easily comprehended and followed. The task which a committee must therefore assume is the preparation of a report which will not consume more than 20 minutes in the reading of it, and can easily be followed and understood by those who hear it. Just to the extent that the reading exceeds that limit of time, and is difficult of comprehension the work of the committee fails in what should be the purpose of their report. If any highly scientific and abstruse investigation or dissertations are essential to the deductions or the conclusions in the report, these should be relegated to appendices to be printed with it but not read.

The reports this year, it is thought, were quite up to the average in interest and value. Some of them are rather tough reading, as for example the one on "Exhaust Pipes," which embraces two distinct investigations, the reports of which are not as lucid as they might be. The report on "Slide Valves" opened an animated discussion and some of the conclusions of the committee were questioned, and on some points the authors were finally driven to the admission that they were not quite sure of their ground. It is to be regretted that the funds of the association would not permit of more complete illustrations of this report, which, if not entirely sound in some of its deductions, was at least very suggestive.

The metrical system of measurement, or rather its compulsory adoption, was also up for consideration, but the measure met with little favor. The advocates of this movement should read Herbert Spencer's article on it, which was published in the June number of Appleton's Popular Science Monthly.

The declination of Mr. Sinclair of the office of Secretary of the Master Mechanics' Association left a vacancy which was filled by he appointment of Mr. Cloud to that office, who thus becomes Secretary of both associations. This, it is hoped by some, may lead to their consolidation.

The time which must now be given by any one who wishes to attend both meetings is greater than most of them who come to them can afford. The sessions at Saratoga began on Tuesday morning and ended at noon on Wednesday of the following week, and changes made in the by-laws will add two days to this period for next year. The Master Mechanics met on Monday morning of the second week. If they should hold their meetings on Monday, Tuesday and Wednesday there seems to be no reason why the Car Builders could not hold theirs on Thursday, Friday and Saturday following, which would compress the whole session into one week, which seems very desirable.

The general verdict of all was that there was no place like Saratoga for these meetings. The hotels give unlimited accommodation to those who attend, and there need be no dissatisfaction on that account. The balmy atmosphere and the aperitive waters seem to incline the sojourners to deliberation, and open their minds to the reception of knowledge and new ideas.

Colonel Clement, the proprietor of Congress Hall, was again entitled to the thanks of his guests, who were entertained by him with the same hospitality that he has dispensed on previous occasions, and many left his hostelry feeling that their thanks were still due to the host after their bills were paid.

NOTES.

The Pullman car service on the Omaha line of the Northwestern Railroad has been displaced by the Wagner car service, through a contract signed about six weeks ago. The Pullman Company is said to have made a hard fight to retain the business; but the Vanderbilt interests in the Northwestern road, which controls the Omaha line, were too powerful to be overcome, and, as a result, the Pullman cars will have to go. This will increase the mileage served by the Wagner Palace Car Company by some 1,500 miles.

Locomotive engineers and firemen in England are urging the adoption of American cabs on English engines. Several meetings of the men have been held at the large railroad centers in order to bring before the companies the adoption of this reform. A committee appointed by the men have examined the cabs on the North Eastern Railway, and an engineer has returned from a visit to this country for the purpose of reporting on our practice, and the resolutions passed at the meetings of the men ask for cabs as good as those on the North Eastern and on the American roads.

The unjust treatment to which many railroads are subjected in the columns of the daily press is aptly illustrated by the case of the Illinois Central. Some of the Chicago dailies cannot refer to the road without employing offensive epithets and no opportunity is lost to influence public opinion against it; and yet this same road pays the state 7 per cent. of its gross earnings on the 705 miles of original road, amounting at present to nearly $700,000 per year. It has altogether paid about fifteen and one-half millions into the state treasury, and twice in the last fiscal year it has come to the aid of the state by paying $300,000 of its taxes in advance. It has spent four or five millions in improvements within the limits of Chicago in the last three or four years, and is now altering the grade of its tracks near the terminals, building sea walls, and co-operating with the city in the improvement of the Lake Front park at an outlay to itself of a million or two, but of course these things should not count in its favor or influeuce the action of the dailies referred to.

In a series of tests conducted on the Buffalo & Niagara Falls Electric Railway by Messrs. H. O. Pond and H. P. Curtis and published in the *Sibley Journal of Engineering*, the following results were obtained:

Friction of the car on straight level tracks	208.5 pounds
Traction coefficient on straight level tracks	6.86 pounds per 1000
Acceleration horse power, from zero to full speed	16.03 horse power
Average current taken by the car in passing over the entire line	63.4 amp
Average voltage on the line, from several tests	513.1 volts
Average electric horse power of car over the entire line	40.44 horse power
Average drop in potential on Buffalo end of line	5.1 per cent
Average speed over the entire line	23 miles per hour
Maximum speed, on a regular run	36 miles per hour
Maximum speed attained	42 miles per hour
Maximum current taken by car during tests	188 amp
Maximum voltage at car during tests	583 volts
Maximum electric horse power of car during tests	143 horse power

During these tests the cars never carried a full load, but generally ran light. The track and overhead construction are of the best. The road has only two grades in its entire length of 22 miles. The cars are 28 feet long over the body, 36 feet over all and weigh 22,000 pounds, with the motors and without passengers. They are carried on the Brill Company's privotal trucks, each truck having two G. E. 800 motors,

With a view of increasing railway construction in India, the Government has announced that on proposed branch and feeder lines approved by it, it will give a guarantee of interest of 3 per cent. per annum on the authorized capital, while in some cases it may be arranged as an alternative that a payment be made to the branch company sufficient to bring up the earnings of the latter to 3½ per cent. on the authorized capital, provided always that the main line company is not called upon to pay more than it has earned from the new traffic. In order to take advantage of these concessions, the branch lines in question must not exceed 100 miles in length. A prior right to construct such feeders will be given to the administrations of the trunk lines, but if they do not undertake it the matter may be taken in hand by other parties. The plans and estimates must be approved by the Government, and any further capital expenditure after completion must also be sanctioned by the same authorities. The Government agrees to provide the land required free of cost, inclusive of quarries, ballast pits, brick fields, etc., and to provide and maintain the telegraph service at the usual charges for such work. Materials for construction will be carried over the State lines at special rates. The

Government reserves the right to purchase such lines at the end of 21 years, at a cost of not more than 20 per cent. above the capital cost of the line nor less than the par value of the same.

According to an article by Mr. Charles E. Barry, in the *Sibley Journal of Engineering*, there is but one producer gas engine plant in commercial operation in this country, and that was built in 1892 by the Danbury & Bethel Car and Electric Company, of Danbury, Conn., for the purpose of supplying electric light to the towns of Danbury and Bethel. The station equipment consists of three 100-horse-power horizontal engines, built by the Otto Gas Engine Works, of Philadelphia, belted to a jack shaft carrying a three-ton flywheel, and from which one 750 and one 1,500-light Westinghouse 1,000-volt alternator, two commercial and three street arc machines are driven. The gas engines are of the twin-cylinder type, having two horizontal cylinders placed one above the other, and working on the one crank. The cylinders are 14½ inches in diameter and 25 inches stroke. In a test these engines produced a horse-power-hour for each 1.129 pounds of coal used in the producer, equivalent to .979 pounds of combustible per hour. The gas per one horse power per hour was 76.3 cubic feet. The engines ran at 164 revolutions per minute. Of the total heat supplied to the engine 39.09 per cent. was absorbed by the jacket water, 25.61 per cent. passed out in the exhaust, 13.66 per cent. was lost through radiation, etc., and 21.64 per cent. converted into useful work. The mechanical efficiency of the engines was 85.39 per cent., and the dynamos 81.53 per cent. The efficiency of the producers was 84 per cent. The jack shaft consumed 35 horse power.

Personals.

W. W. Finley has been chosen Vice-President and Manager of the Great Northern.

Mr. H. H. Rogers, of New York, has been chosen President of the Ohio River Railroad.

Mr. J. E. Cannon has been promoted to the position of Master Mechanic of the Great Northern at Barnesville, Minn.

Mr. Frank T. Hyndman has been appointed Master Mechanic of the Pittsburgh & Western, vice J. N. Kobaugh, resigned.

Mr. Frank Singer has been appointed Master Mechanic of the Midland Terminal Railway, with headquarters at Gillett, Col.

Mr. W. V. McCracken has retired from the Presidency of the Louisville, St. Louis & Texas owing to the reorganization of that property.

Mr. S. W. Fordyce has been made Receiver of the Stuttgart & Arkansas River Railroad, and Mr. H. E. Martin is Manager for the Receiver.

Mr. J. M. Schoonmaker, of Pittsburgh, Pa., has been chosen Vice-President of the Pittsburgh & Lake Erie, to succeed Mr. James H. Reed, resigned.

Mr. R. F. Hoke, President of the Georgia, Carolina & Northern, has been chosen President of the North Carolina Car Company in place of Mr. Julius Lewis.

Mr. H. N. Woodward has been appointed Master Mechanic of the Baltimore & Ohio shops at Parkersburg, to succeed Mr. J. H. Irvin, assigned to other duties.

Mr. D. L. Anderson has been appointed Secretary and Purchasing Agent of the Louisville, Evansville & St. Louis, with headquarters at Evansville, Ind.

W. S. Calhoun, who has been the railroad representative of the Brussels Tapestry Company, of Chauncey, N. Y., has been appointed General Manager of the Company.

Mr. Attilla Cox, receiver of the Louisvile St. Louis & Texas, has been chosen President of the reorganized company, which will be known as the Louisville, Henderson & St. Louis.

Mr. George S. Edgell has been elected Second Vice-President of the Long Island Railroad. He is a son-in-law of the late Austin Corbin, formerly President of the Long Island Railroad.

Mr. Wm. P. Palmer has been elected Second Vice-President of the Illinois Steel Company, vice Mr. Robert Forsyth, resigned. He will look after the commercial interests of the company.

Mr. C. H. Warren has resigned as General Manager of the Montana Central, which has heretofore been operated by the Great Northern, and it will hereafter have its own corps of officials.

Mr. William J. Fransioli has been appointed Acting General Manager of the Manhattan Railway, of New York City, to succeed F. K. Hain, deceased. He was formerly chief clerk to General Manager Hain.

Mr. W. R. Stirling has resigned the Vice-Presidency of the Illinois Steel Company to devote his entire time to the Universal Construction Company, which recenty leased the north works of the Illinois Steel Company.

Mr. O. O. Winter, Division Superintendent of the Great Northern at Minneapolis, Minn., has resigned to accept the position of General Manager of the Brainerd & Northern Minnesota, with headquarters at Brainerd, Minn.

Mr. W. E. Looney has retired from the position of Master Car Builder of the Louisville, Evansville & St. Louis, and the office has been abolished. The master mechanic will hereafter have charge of the car department.

It is announced that Mr. Archie McLean has been appointed Superintendent of Motive Power and Equipment of the Georgia Northern road, vice Mr. Albert Marugg, resigned. Mr. McLean's headquarters will be at Pidcock, Ga.

Mr. Parley I. Perrin, for many years Superintendent of the Taunton Locomotive Works, died at Taunton last month, in the eighty-fourth year of his age. He joined the Taunton Locomotive Works as draftsman and foreman in 1846.

Mr. C. B. McCall, General Freight and Passenger Agent of the Chicago, Paducah & Memphis, has been appointed General Manager of the Litchfield, Carrollton & Western, with headquarters at Carlinville, Ill., in place of Mr. T. D. Hinchcliffe, resigned.

Mr. C. P. Clark has been appointed Assistant General Manager of the New England Railroad, with office at No. 180 Summer street, Boston. The duties of the Assistant General Manager will be the same as those assigned by the Board to the General Manager.

Mr. J. J. Turner, Vice-President and General Manager of the Vandalia Line, will remove his headquarters from Terre Haute, Ind., to St. Louis, Mo., July 1. Mr. Charles R. Peddle, Purchasing Agent of the road, will also remove his headquarters to St. Louis at the same time.

Mr. St. John Boyle has been made sole Receiver of the Chesapeake, Ohio & Southwestern, owing to the death of Gen. John Echols, who was associate Receiver and General Manager. Mr. Boyle will also act as General Manager until the road is turned over to the Illinois Central.

Mr. E. L. Weisgerber has been appointed Master Mechanic of the Mt. Clare shops of the Baltimore & Ohio Railroad. He was formerly Master Mechanic of the shops at Newark, O. Mr. William Harrison, Jr. has been appointed Master Mechanic of the shops at Newark, O., to succeed Mr. Weisgerber.

Mr. E. S. Marshall, formerly Master Mechanic of the St. Louis & Southwestern Railroad, is now Assistant Manager of the Railway Equipment Company, of St. Louis, which manufactures and sells the Houston track-sanding device, the economical slack adjuster and several other railroad devices. Mr. Marshall is also Manager of the Railroad Department of the Missouri Malleable Iron Company, of East St. Louis, Ill.

Mr. D. B. Robinson has accepted the Presidency of the St. Louis & San Francisco, which is undergoing reorganization, and has tendered his resignation as First Vice-President of the Atchison, Topeka & Santa Fe, to take effect July 1. Mr. Robinson has been in railway service since 1866, and has been First Vice-President of the A., T. & S. F. since March 7, 1893. His headquarters as President of the St. Louis & San Francisco will be at St. Louis, Mo.

Arthur B. Underhill, for many years Superintendent of Motive Power of the Boston & Albany, died at Springfield, Mass., May 24. He was born at Chester, N. H., October 23, 1832, and entered railway service in 1860 as Foreman Repair Shops, Boston & Worcester. From 1864 to 1880 was Master Mechanic of the Boston & Worcester. He was appointed Superintendent of Motive Power of Boston & Albany, September 1, 1880, which position he held until December, 1893, when he resigned on account of ill health.

On June 18th the degree of Doctor of Engineering was conferred by the faculty and trustees of Stevens Institute upon Commodore George W. Melville, Engineer-in-Chief of the United States Navy, in appreciation of the excellent engineering work performed by Commodore Melville for his country and the advancement of the science of steam engineering, so well illustrated in the world-wide famed "white squadron." Only once before in the 25 years' history of the Stevens Institute has the degree of Doctor of Engineering been conferred, and then upon Prof. R. H. Thurston, of Rhode Island, who formerly occupied the chair of Mechanical Engineering in Stevens Institute and is now Director of Sibley College, Cornell University.

Mr. Edwin M. Winter, General Manager of the Chicago, St. Paul, Minneapolis & Omaha, has been selected by the Northern Pacific Reorganization Committee to be President of the company. Mr. Winter has been with the Chicago, St. Paul, Minneapolis & Omaha since 1876. He was born in Vermont in 1845, and entered railroad service in 1867. His first work was in the construction department of the Union Pacific, where he remained for about three years. Subsequently he was a contractor's agent for construction work on various railroads, General Claim Agent for the Chicago & Northwestern, General Superintendent of the West Wisconsin, and has held his present position of General Manager since 1885.

Mr. Austin Corbin, President of the Long Island Railroad, was fatally injured by a runaway team at his summer residence at Newport, N. H., on June 4. Mr. Corbin was born at Newport, N. H., July 11, 1827, and graduated from the Harvard Law School in 1849. In 1851 he removed to Davenport, Ia., where he lived for 14 years. He located in New York in 1865 and established the banking house of Austin Corbin & Company. Soon thereafter he secured control of the Long Island Railroad, which he extended from year to year, until it has become a great system, reaching almost every portion of Long Island. He was at different times interested in many other railway enterprises, being President of the Indiana, Bloomington & Western; President of the Philadelphia & Reading road from September, 1866, to June 27, 1890; President of the Elmira, Cortland & Northern, and in 1892 was for a few months President of the New York & New England.

Gen. John B. Gray, Vice-President of the American Brake Company, whose home for several years has been in Brooklyn, N. Y., died of Brights disease at Asheville, N. C., on June 6, 1896, after a lingering illness. General Gray was born at Sheridan, June 25, 1831. The beginning of his business career was in New York City, but, on becoming of age, he removed to St. Louis Mo., where he was engaged in mercantile business for some ten years prior to the war. He had an honorable career during the war, and at its close was offered at different times several important positions in the service of the government. These he declined. In 1880 he became connected with the American Brake Company, of St. Louis, of which he was President for several years. In 1888 he was instrumental in effecting a lease of the American Brake Company to the Westinghouse Air Brake Company, and has, since that time, had general charge of the eastern business of the driver brake department of the Westinghouse Air Brake Company. During the past two years his health has been continually declining. Last summer he went abroad for several months, and shortly after his return he went to Asheville, N. C., where, the climate seeming to benefit him, he commenced building a home, which was not yet quite completed at the time of his death.

Equipment Notes.

The Erie Railroad is in the market for 20 locomotives.

The Chicago, Paducah & Memphis road is negotiating for 500 to 1,000 cars.

The Cleveland, Lorain & Wheeling has placed an order with the Peninsular Car Works for 300 30-ton flat cars.

The Barney & Smith Car Company is building three closed and fourteen open cars for the Mount Clements electric road.

The Georgia & Alabama Railroad has ordered eight passenger coaches from the Ohio Falls Car Manufacturing Company.

About 100 refrigerator cars are being fitted up at the Philadelphia, Wilmington & Baltimore shops at Wilmington, for the shipment of fruit.

The Michigan-Peninsular Car Company, Detroit, Mich., has received an order from the Lehigh Valley Railroad Company for 50 double-deck stock cars.

The Ensign Manufacturing Co., of Huntington, W. Va., has been awarded the contract for 100 thirty-ton hopper gondola cars for the Chesapeake & Ohio.

The Ohio Falls Car Manufacturing Company has received an order from the Baltimore & Ohio Southwestern Railroad Company to repair 600 freight cars.

The Chicago, Burlington & Quincy has placed orders for 1,000 stock cars; 750 to go to the Michigan Peninsular Car Company and 250 to the Wells & French Company.

The Florida & East Coast Railroad has placed an order with the Elliott Car Works for 100 freight cars. This road is in the market for additional equipment.

At the shops of the Pennsylvania, at Fort Wayne, there have recently been completed 175 gondola cars, and work has been now commenced on the building of 25 cars for dairy product and 10 large furniture cars.

The Wagner Palace Car Company's shops have turned out two compartment cars for service on the Chicago & Northwestern road, which are considered superior in beauty of finish to anything ever turned out of the shops.

The Billmeyer & Small Car Company, York, Pa., has under construction four cars for Bolivia, South America, where they will be used for excursion purposes. They are also building four for Venezuela, adapted for carrying sugar cane.

The Brooklyn Heights electric road, Brooklyn, N. Y., has recently added to its equipment a third theater car, built by the J. G. Brill Company, Philadelphia, Pa. The length over end panels is 24 feet; width at sill, 7 feet and width at Belt rail, 7 feet.

The Texas Midland Railroad has placed an order with the St. Charles Car Company for $125,000 worth of rolling stock. The order includes seven new coaches, five baggage cars, fifty furniture cars, ten tank cars, five cabooses and a private car.

The Imperial Railways of North China will receive proposals for building four passenger and four freight locomotives for use on the extension of the road from Tien Tsin to Lu-Kon-Chiao.

The bids will be opened at the company's office at Tien Tsin, August 25.

It is announced that the Northern Pacific is about to change four of its standard mogul 18 by 24 engines into compounds. They will all be different types—Richmond, Schenectady, Brooks and Pittsburgh. The intention is to put them into service, running against simple engines.

Four new sleeping-cars have just been sent from the Wagner Palace Car shops, at East Buffalo, to St. Paul, Minn., for use on the Chicago, St. Paul, Minneapolis & Omaha. These are the first Wagner cars used on the road, this company having recently taken the business away from the Pullman Company.

The Illinois Central has awarded a contract for 500 coal cars to the Wells-French Company, and 300 refrigerator cars to the United States Rolling Company. These last named cars will be built at the Hegewich plant of the company. It is rumored that the road will soon place another and large order for cars.

The contracts for some of the 75 Baltimore & Ohio engines were let shortly after our June issue went to press. Other contracts followed and the orders are now distributed as follows: Richmond Locomotive Works, 25; Baldwin Locomotive Works, 20; Pittsburg Locomotive Works, 20, and Cook Locomotive Works, 10.

At a recent test of the Baldwin-Westinghouse Electric Locomotive at the shops of the Westinghouse Air Brake Company, at Wilmerding, Pa., a speed of 45 miles an hour was developed, the engine hauling 25 freight cars. In the near future a public test of the engine will be made, to which a large number of railroad men will be invited.

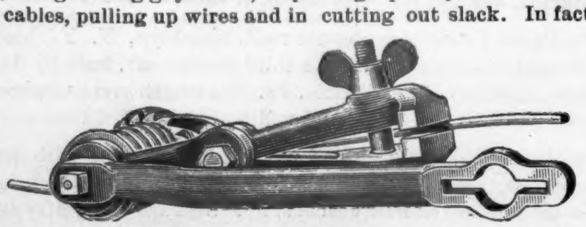
Eight new coaches and six new Wagner Sleeping cars have been put into the daily through service between New York and Montreal, via the Adirondack & St. Lawrence division of the New York Central. The day coaches have accommodations for first and second-class passengers. New mail and express cars will also be assigned to these trains.

As illustrating the heavy expense which railroads are compelled to incur in equipping the cars with automatic brakes and couplers, it may be cited that the receivers of the Baltimore & Ohio have asked and obtained authority from the court to borrow $409,851 in addition to money already spent for the equipment of the rolling stock with brakes and couplers in conformity to law.

It has been stated in several papers that the Richmond Locomotive Works has received an order from the Chicago, Cleveland, Cincinnati & St. Louis Railway to convert 60 locomotives into compounds. This is not true. They are to convert a few engines only at present, and if they are satisfactory others may be changed from time to time, as they require heavy repairs on the cylinders and attached parts.

The Doherty Patent Combined Vise and Winch.

Brown, Jaeger & Company, No. 919 Betz Building, Philadelphia, Pa., are the sole manufacturers of the Doherty combined vise and winch, which is shown in the accompanying cut. The manner of using it is apparent at a glance. This tool will evidently in a short time replace the old-time "strap and vise" or "block and fall" used at present in telegraph, telephone, trolley wiring, electric light line work, in tightening guy wires, in putting up suspension wires for ærial cables, pulling up wires and in cutting out slack. In fact it



can be used for stringing wires of every description upon poles or fixtures of any kind and in tightening all gages of wire to any advisable degree of tension.

It is available for use in making repairs to "live wires" without the necessity of employing the usual "cut outs" thus preserving the linemen from the danger of the "cut out" falling off. The tool itself being entirely of metallic construction completes the circuit. On electrical test it has been shown, that the Doherty combtned vise and winch shows no resistance. The usefulness and worth of the implement is summed up in the following statement: One man can pull up two miles of wire at one time with greater ease, more quickly and more effectively, than the usual gang of four men can pull up two ordinary sections with the "strap and vise" or "block and fall" in use at present. As an indication of its power, it is only necessary to state that it can pull apart a No. 8 iron wire in an ordinary section. Its merit lies in saving money, labor, time, and life. The weight of the tool is about six pounds.

The Niagara Spray Ejector for Urinals.

To economize in the use of water and also to overcome the annoyance from clogging, so often experienced in flushing slab urinals by means of perforated pipe, S. J. Putnam, Prince's Bay, N. Y., has brought out the fixture shown in the appended illustrations.

The ejector shown in Fig. 1 may be secured into the front side of

Fig. 1.

the supply pipe which passes across the stall, in the place of perforated pipe.

The force of water on the internal spherical head of the screw cap at the slot, throws a fan-shaped spray obliquely against the slab, flushing the entire surface in an efficient manner. As the outlet is

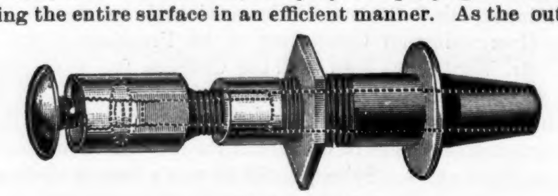


Fig. 2.

equal to only two holes in a perforated pipe, a large saving of water s evident, and owing to its peculiar construction there is but little chance for clogging. If the spray should become clogged by rust or dirt it can be instantly cleared without disturbing the couplings. A minimum of pressure may be obtained by using a stop-cock, which will also add to the amount of water saved. The screw-cap has a lock, therefore no part can get lost or destroyed.

The special coupling shown in Fig. 2, is used for high slab work

Fig. 3.

where the supply pipes are behind the slab. It passes directly through the slab and is clamped firmly to the same by the nut, which is provided with left-hand thread.

Fig. 3 shows two stalls with fixtures complete and water turned on. Mr. Putnam will cheerfully furnish fuller information to those of our readers writing him

The Dickerman Buffing Lathe.

The buffing lathe illustrated herewith is made by the Dickerman Emery Wheel and Machine Company, Bridgeport, Conn., and is a departure, to a certain extent, from machines of this character. The spindle has a bearing the entire length of each box, precluding any whipping or jumping of the spindle from belt action. It is

Dickerman Buffing Lathe.

turned from machinery steel and means are provided for taking up end thrust. A maximum amount of room beneath the spindle for buffing large pieces is obtained by having no projections on either the base or the underside of the boxes. The machine is especially adapted for buffing bicycle frames and similar work. The dimensions are: Height, floor to center of spindle, 40 inches; diameter of spindle in bearings, $1\frac{1}{8}$ inches; diameter of spindle at wheel fit, $1\frac{1}{4}$ inches; length of bearings, $14\frac{3}{4}$ inches each; length of spindle, 50 inches; distance between fields, 40 inches; spindle pulley, 6-inch face by 5-inch diameter; floor space over all, 22 by 50 inches. The Pratt & Whitney Company, 123 Liberty street, New York City, are the New York agents.

A New Locomotive Boiler Covering.

The accompanying cut shows a new fireproof covering recently brought out by the Kelley Company, of Mineral Point, Wis., to meet the want of master mechanics for a lagging for boilers that is

fireproof, that can be removed for repairs and again replaced, and that is cheap.

This covering is composed of strips of wood, treated in such a way as to be incombustible, and fastened together side by side so that every fourth strip is raised about one-half inch above the surface of the other three, these raised strips either being notched, as shown in the cut, or left whole. As this side is placed next to the boiler, it will, of course, form air spaces, which may, or may not, be filled with mineral wool, as desired. These strips have a backing of heavy paper board covered with asbestos paper, the whole being securely fastened together without nails or other metal fastening. It may thus be sawed or cut out to fit rivets or seams, and can also be made of any size to fit the sheets, and any curvature of the boiler. This covering is very strong, and may be walked on without injury. By means of the new patented device for fastening it on, any section of the covering may be removed at any time for repairs or examination and again replaced, without disturbing or loosening any other section. It gives a smoother surface for jacketing than wood lagging, and when it is further known that the cost is only about the same as that of wood, it will readily be seen that it is worthy of careful consideration.

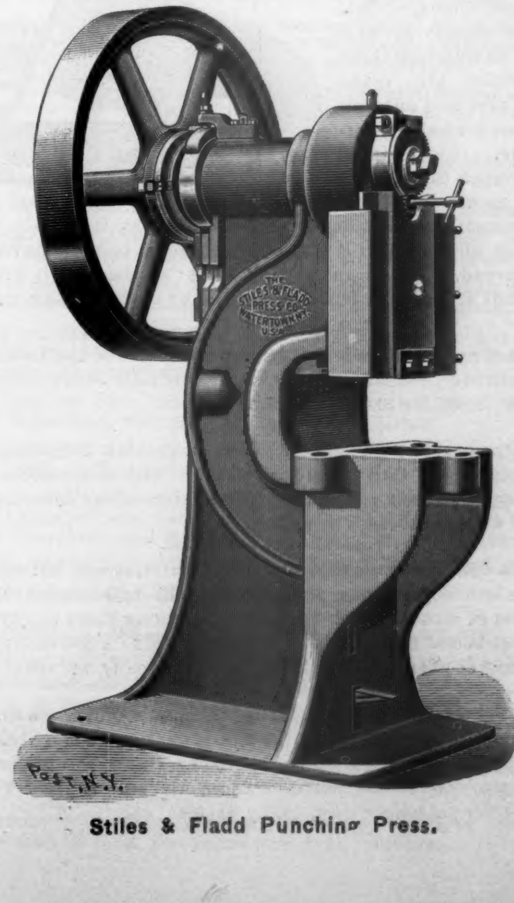
Improved Punching Press.

In the accompanying cut we illustrate a new punching press, which, while it follows in a general way the well-known Stiles press, embodies certain improvements. No great innovation can be introduced into a design of a punching press, in which a frame is in one solid casting, but the company putting this improved Stiles press on the market make their especial claim for excellence of workmanship and the selection of each separate kind of material of which the press is constructed.

Only a special mixture of iron of great strength is used in their castings and this mixture is continually tested and every care taken to keep it up to an established standard. Every part on which the slightest wear occurs is carefully scraped to an exact fit and a perfect bearing surface thereby provided.

The ways or guides of the slide are made exceptionally long to resist any side thrust without undue wear. The clutch adopted by this company to be used on this press in preference to all others, is one that has been perfected and recently patented by the inventor of the original Stiles clutch and Stiles press and is claimed to be superior in many ways to that well-known clutch. Among the special features we note the ability to run the press in either direction equally well; three points of contact in the wheel cause the clutch to be practically instantaneous; the operator can cause the press to make a whole revolution or only a part, as he may desire which is a valuable feature, as it prevents accidents to tools and operators, and makes this clutch absolutely safe. The clutch can be used to back out a punch that may become stuck in the die, and is claimed by the manufacturers to be the latest and best press clutch built.

These presses are manufactured by the Stiles & Fladd Press Company, of Watertown, N. Y., in six sizes weighing from 500 to



Stiles & Fladd Punching Press.

7,500 pounds, as fly presses, and in five sizes ranging in weight from 1,200 pounds to 8,000 pounds, as geared presses. The patterns are so constructed that an endless variety of modifications and changes can be made to adapt them to special work and tools of any make.

The Q & C Hoyt Flush Car Door.

The accompanying drawings show the new Q & C Hoyt Flush Car Door, which is being brought out by The Q & C Company. It will be noticed that there are several new features embodied in this door that are worthy of careful investigation, the first of which is an absolutely flush door, hanging from the top without a bottom rail of any kind. This entirely does away with any danger of injury to the door at this point, besides reducing the weight and number of fixtures nearly one-half.

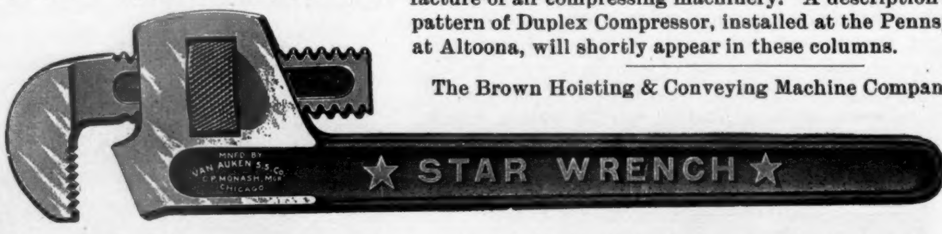
The parts needed at the top of the door are two hangers, the track and the track brackets, and the only parts used at the bottom of the door are a sliding guide bracket and catch which recedes into the sill of the car as the door closes. This is a novel feature in itself, which has been demonstrated to be thoroughly practical as nothing projects from the side of the car to be knocked off.

The locking device at the rear edge of the door is of such a design as to make it positively necessary to break the seal before the car can be entered. Besides this it acts as a leverage to throw the door into place and hold it there. The power of this lever is so great that it will throw a badly sprung door into its place with but little effort, making an absolutely storm-proof door.

As a flush door it is claimed to be the cheapest in first cost, to have the least number of parts, to be easy to apply, and that the expense of maintenance is but very little, if anything.

The Star Pipe Wrench.

The accompanying cut illustrates the star pipe wrench, which is manufactured by the Van Auken Steam Specialty Company, C. P. Monash, Manager, 203 South Canal street, Chicago. This wrench is simple in construction, having but three pieces, which are made with such care and uniformity as to be perfectly interchangeable. It is claimed for this wrench that it does not stick on the pipe, but releases instantly, that it has no lost motion, that it cannot mash the pipe or slip off, and it is guaranteed never to strip, having an oval top thread. On account of the "slant" on the heel, it will also ratchet a nut or coupling without marring or rounding the corners.



A contract has been awarded by the Receivers of the Baltimore & Ohio Railroad Company to the Continuous Rail Joint Company, of Newark, N. J., for 50,000 rail joints.

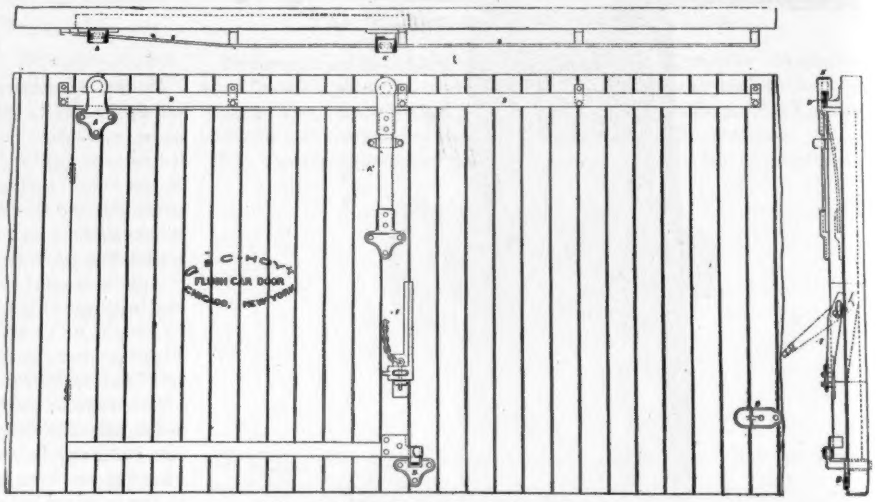
Messrs. Bruner, Sprague & Co., 1027-8 Manhattan Building, Chicago, agents for the Sall Mountain, Georgia, asbestos, besides very flattering sales of their product to railroad for boiler covering, report a call for the asbestos from Japan.

The Gibbs Electric Company, 169 to 177 Clinton street, Milwaukee, Wis., have issued a number of illustrated sheets showing the different styles of motors which they build. Among these is a type M motor direct belted to a quartering machine, also a 20-horse power steel clad motor geared to a Hiles & Jones Company bar shear.

The Georgia Car and Mnnufacturing Company, of Savannah, will erect a plant to consist of an engine and boiler house, 75 by 109 feet; a machine, blacksmith and workshop, 106 by 375 feet; a building for the office; also warerooms, patterns and cabinet work, 106 by 150 feet; a shop for passenger cars, 106 by 500 feet, etc.

The Standard Car Wheel Company, of Cleveland, O., has been incorporated, with a capital stock of $75,000. The incorporators are: N. P. Bowler, of Bowler & Company; C. A. Brayton, formerly of Maher & Brayton; W. L. Bowler, W. B. Brayton and Francis J Wing. The new company has purchased the car wheel foundry of Bowler & Company.

If any of our readers do not thoroughly understand the new and simple method by which lead pipe can be coupled to lead pipe or to iron pipe instead of wiping or soldering the joints, they should write at once to The Van Auken Steam Specialty Company, 208



The Q & C Hoyt Flush Car Door.

South Canal street, Chicago, for their illustrated catalogue of Star Lead-pipe Couplers and Fittings. In doing so please mention this journal.

The Clayton Air Compressor Works, Havemeyer Building, New York, report a gratifying increase in their volume of business during the past few months, over the same period last year. The rapid extension in the field of application for compressed air was foreseen by these works several years ago, when they discontinued other lines and devoted their sole time and attention to the manufacture of air compressing machinery. A description of their latest pattern of Duplex Compressor, installed at the Pennsylvania shops at Altoona, will shortly appear in these columns.

The Brown Hoisting & Conveying Machine Company have closed a contract with the Pennsylvania Railroad for one Brown double cantilever machine for handling general merchandise on Pier J, Jersey City, to and from ocean steamers to cars. This machine has been designed especially for its location. It will hoist its maximum load of five tons 150 feet per minute, while the entire machine will be able to travel along the pier at the rate of 600 feet per minute. It is operated by steam and will be handled by a single operator. It is said to be the first machine specially designed for the rapid handling of freight to be erected in New York harbor.

The Chicago Rawhide Manufacturing Company, 75 East Ohio street, Chicago, Ill., have for the past eighteen years been manufacturing rawhide pinions. Their extended experience enables them to turn out a superior article—one that has met with the greatest success. The pinions are noiseless and greatly reduce the friction; furthermore, they do not wear out the meshing gear, yet they outwear metal pinions, thereby effecting a great saving in both directions. The company also make rawhide bell and register cord, remarkable for its strength and durability. Other products of their factory are leather belting, and rope for rope transmission. In connection with the latter they have a patented connection for making a splice without increasing the size of the rope, while retaining its full strength, thus overcoming a great objection to ordinary rope transmission, either by manilla or wire rope.

New Publications.

COMPRESSED AIR.—A monthly publication devoted to the useful application of compressed air. Published by W. L. Saunders, 26 Cortlandt street, New York. Subscription price, $1.00 per year.

This interesting periodical is only four months old, but it has developed wonderfully in that brief period. The rapidly extending use of compressed air for power purposes in all kinds of shops, in contractors' work, and in other lines too numerous to mention, gives this paper a large and growing field. From its pages it is evident that its editors and publisher are directing the attention of its readers to the thoroughly practical uses of compressed air and the most economical methods of employing that useful agent. That is just what is needed, and we can heartily commend the publication to those who are or ought to be interested in the compression, transmission or use of air.

HEALTH AND PLEASURE ON "AMERICA'S GREATEST RAILROAD." *Descriptive of Summer Resorts and Excursion Routes, Embracing more than One Thousand Tours by the New York Central & Hudson River Railroad.* Issued by the Passenger Department. New York; 532 pages; 6 by 9 inches. (Standard size.)

Each year the guide books which are published by the different lines of railroad are increased in size and elaborateness. The discoveries which have been made in the various processes of photo-engraving have facilitated very much the production of this class of literature, and have made possible a richness of illustration which our fathers never dreamed would be possible.

The volume before us has been issued by the passenger department of the New York Central Railroad, and is intended to set forth the attractions of that great line of travel.

At the beginning of the book is an excellent large folded map 3 ft. 3½ inches by 16 inches of the line and its connections from Boston to St. Louis. The different single-track roads are represented by one broad red line, double track by two and quadruple track by four.

The first chapter is devoted to a general description of the New York Central Railroad and its branches. The second chapter—33 pp.—to the Hudson River division and its environment, with a great many illustrations of interesting places and objects along and adjacent to the road. Among them are a number of historical scenes and much beautiful landscape.

The third chapter describes the Putnam division of the road, and the counties and places adjacent thereto. Excellent views are given of the High and Washington bridges in New York, buildings and scenes along the line of the road; some of them, such as the scene opposite p. 72, are of great beauty. Following this chapter is one of 34 pp. devoted to the Harlem division, and containing many admirable illustrations. "The Beautiful Mohawk Valley" is the title of the succeeding chapter, and embraces that part of the line from Albany to Utica. Other chapters describe the Lake Region of Central New York, the Auburn road, Rochester to Buffalo and Niagara Falls, Rochester and Niagara Falls road, the Adirondack Mountains, with a multiplicity of views of lakes, mountains and hotels. About 70 pp. are devoted to descriptions of places which may be reached by the New York Central road. The terminal facilities in New York are described, and about 90 pp. are given up to information concerning steamboat and stage lines, followed by schedules which relate directly or indirectly to the great road which is the subject of this elaborate volume.

About 50 pages are devoted to tables, giving rates of fare, lists of hotels and boarding-houses along the line, and much other information of interest to travellers. Over 100 pages of very interesting advertisements complete the book.

It is not easy in a brief notice like this to give an adequate idea of the wealth of illustrations which are given. The mere enumeration of them would take a great deal of time. It is safe to say that there are several hundred. Most of them are of a very excellent character of engraving. A number of them—as for instance that on page 140, "Great Expectations,"—have much artistic merit.

The style of the descriptive matter is very pleasant, and there is a grateful absence of the guide-book style, which in some productions of this kind is so "averting." The price of the book is 25 cents, and is the cheapest publication we know of for the money. The fault to be found with it is that its perusal produces a desire—which is difficult to resist—to pack up and take an early train to some of the agreeable places which are described.

Our Directory

OF OFFICIAL CHANGES IN JUNE.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Mr. D. B. Robinson has resigned the office of First Vice-President.

Baltimore & Ohio.—Mr. E. L. Weisgerber, formerly Master Mechanic at Newark, O., has been transferred to the position of Master Mechanic of the Mont Clare shops, Baltimore. Mr. Wm. Harrison, Jr., succeeds him at Newark. Mr. H. N. Woodward has been appointed Master Mechanic at Parkersburg to succeed Mr. J. H. Irvin, assigned to other duties.

Brainerd & Northern Minnesota.—Mr. O. O. Winter has been appointed General Manager, with headquarters at Brainerd, Minn.

Chesapeake, Ohio & Southwestern.—Gen. J. Echols, Receiver and General Manager, died May 24. Mr. St. John Boyle has been made sole Receiver, and will act as General Manager until the road is turned over to the Illinois Central.

Georgia Northern.—Mr. Archie McLean has been appointed Superintendent of Motive Power, with headquarters at Pidcock, Ga., vice Mr. A. Marugg, resigned.

Great Northern.—Mr. W. W. Finley has been elected Vice-President and General Manager. Mr. J. E. Cannon has been appointed Master Mechanic at Barnesville, Minn.

Houston, East & West Texas.—T. W. House has been chosen President.

Litchfield, Carrollton & Western.—Mr. C. B. McCall has been made General Manager, with headquarters at Carlinville, Ill., vice Mr. T. D. Hinchcliffe, resigned.

Long Island.—Mr. George S. Edgell has been elected second Vice-President. Mr. Austin Corbin, President, was killed in an accident last month.

Louisville, Evansville & St. Louis.—Mr. D. L. Anderson has been appointed Secretary and Purchasing Agent, with headquarters at Evansville, Ind. Mr. W. E. Looney has resigned the position of Master Car Builder, and the office is abolished.

Louisville, St. Louis & Texas.—Mr. W. V. McCracken has retired from the Presidency, and is succeeded by Mr. Attilla Cox. The reorganized road will be known as the Louisville, Henderson & St. Louis Railroad.

Manhattan.—Mr. Wm. J. Fransioli has been appointed Acting-General Manager, vice Col. F. K. Hain, deceased.

Midland Terminal.—Mr. F. Singer has been appointed Master Mechanic, with headquarters al Gillett, Col.

Montana Central.—Mr. C. H. Warren has resigned the position of General Manager. The road will not be operated hereafter by the Great Northern, but will have it own corps of officials.

New England.—C. P. Clark has been appointed Assistant General Manager, and will perform the duties heretofore performed by the General Manager. Office, 180 Summer street, Boston.

New Orleans & Western.—J. M. Turner, Superintendent of Motive Power, has been appointed General Manager. C. B. Deasom has been appointed Chief Engineer.

Northern Pacific.—Mr. Ed. M. Winter has been elected President.

Ohio River.—Mr. H. H. Rogers has been chosen President.

Pittsburgh & Lake Erie.—Mr. J. M. Schoonmaker has been chosen Vice-President, to succeed Mr. J. H. Reed, resigned.

Pittsburgh & Western Railway.—Frank T. Hyndman has been ppointed Master Mechanic, vice I. N. Kolbaugh, resigned.

Sherman, Shreveport & Southern.—Mr. F. W. Fratt has resigned the position of General Manager and the duties of the office will devolve upon the Superintendent.

St. Louis & San Francisco.—Mr. D. B. Robinson has been elected President, with headquarters at St. Louis.

Stuttgart and Arkansas River R. R.—S. W. Fordyce is Receiver. H. E. Martin is Manager for Receiver.

Wiscasset & Quebec.—Mr. R. T. Rundlett has resigned the position of President and General Manager. Mr. H. Ingalls has been elected President, and Mr. W. F. P. Fogg, General Manager.

Exhibits at the Conventions.

The exhibits at the conventions were larger and more numerous than on any previous year and were worthy of careful and minute inspection and study. The following is a complete list of them:

Adams & Westlake Company, Chicago; curtain fixtures, etc. Represented by L. A. Gray, T. B. Jones and H. E. Keeler.

Alexander Car Replacer Manufacturing Company, Scranton, Pa.; steel engine and car replacers. Represented by E. B. Whitcomb.

American Balance Slide Valve Company, San Francisco, Cal., and Jersey Shore, Pa.; slide valves. Represented by J. T. Wilson.

American Brake Beam Company, Chicago; Kewanee brakebeam. Represented by E. G. Buchanan and J. G. Sanborn.

American Steel Foundry Company, St. Louis; car trucks, bolsters, cast steel locomotive frames, couplers and steel castings in general. Represented by C. B. Evans, J. W. Robinson, E. F. Goltra.
American Steel Castings Company, Thurlow, Pa.; cast-steel driving wheel centers, locomotive frames and other steel castings. Represented by D. Egan, S. A. Watson and W. A. Blanchard.
Armstrong Bros., Chicago; machinists' tools and supplies. Represented by P. Armstrong.
Ashton Valve Company, Boston; safety valves and steam gages. Represented by F. A. Casey.
Automatic Dumping Car Company, New York; door-operating device for hopper-bottom cars. Represented by Wm. McMahon.
Boston Belting Company, Boston; rubber goods. Represented by Geo. H. Forsyth, J. F. Muldoon, Fred T. Alden, T. R. Freeman.
Burrows Company, E. T., Portland, Me.; car curtains. Represented by Harry H. Russell.
Brown Automatic Car Coupler Company, Columbus, Ind.; car couplers. Represented by W. G. Irwin and P. C. Brown.
Barbey & Company, F. A., Boston; Hampson flexible steam joint. Represented by F. A. Barbey.
Buckeye Malleable Iron & Coupler Company, Columbus, O.; Little Giant Coupler. Represented by J. E. Howe, J. Timms, C. D. Bailey, C. H. McKibbin and R. C. Fraser.
Bundy Manufacturing Company, Binghamton, N. Y.; time recorder. Represented by H. E. Bundy and C. J. Morehouse.
Bushnell Mfg. Company, Easton, Pa.; car seats. Represented by E. Bushnell and C. Pullman.
Bourne, E., Vancouver, B. C.; Fader dump car.
Baker, William C., New York; car heater. Represented by W. C. Baker and J G. Demarest.
Bird & Son, F. W., East Walpole, Mass.; car roofing. Represented by M. A. Garrett.
Boston Woven Hose and Rubber Company, Boston; rubber goods. Represented by A. L. Whipple, Jr.
Bridgeport Car Equipment Company, Bridgeport, Conn.; third rail system for electic cars.
Brussells Tapestry Company, Chauncey, N. Y.; car window and berth curtains, mattresses, rugs, head linings and the "Perfect" self-adjusting curtain fixture. Represented by W. S. Calhoun.
Brill Company, J. G., Philadelphia; model of truck. Represented by L. B. Smyser.
Bruner, Sprague & Company, Chicago; asbestos lagging for locomotives, fire-proofing and insulation for cars. Represented by H. C. Bruner and J. H. Sprague.
Chase & Company, L. C., Boston; plush goods. Represented by R. Bishop, Jr.
Chicago Grain Door Company, Chicago; grain door and security lock bracket. Represented by J. L. Mallory.
Chicago Pneumatic Tool Company, Chicago; pneumatic hammers, sand-papering machines, piston air drills, air hoists, flue expanders, pneumatic belt shifters, and other pneumatic devices. Represented by J. W. Duntley, W. O. Duntley, J. F. DeGarmo, I. W. Davis and J. Boyer.
Chicago Railway Equipment Company, Chicago; National Hollow brake-beam. Represented by E. B. Leigh, A. J. Farley, L. C. Burgess and F. Ely.
Consolidated Car-Heating Company, Albany, N. Y.; Pope light. Represented by C. A. Sheldon, J. F. McElroy, W. N. Stevens, R. P. Scales, W. P. Cosper and F. P. Foley.
Carnegie Steel Company, Pittsburgh; steel cars. Represented by T. C. Carson, George H. Wightman, H. M. McIlwain, H. J. Lindsay and J. B. Hardie.
Crown Car Coupler Company, Troy, N. Y.; car coupler. Represented by F. Waller and G. H. Mowers.
Crosby Steam Gage and Valve Company; gages and valves. Represented by E. C. Bates.
Detrick & Harvey Machinery Company, Baltimore, Md.; bolt-cutting machinery. Represented by T. M. Brown.
Davis Car Shade Company, Portland, Me.; car shades. Represented by E. E. Piper and C. M. Fuller.
Eureka Nut Lock Company, Pittsburgh; nut locks for car construction. Represented by S. D. Barnett.
Evans Artificial Leather Company, Boston, Mass.; leather substitute for upholstering car seats. Represented by W. N. Dole and A. E. Prince.
Falls Hollow Stay Bolt Company, Cuyahoga Falls, O.; stay bolts and stay-bolt iron. Represented by C. M. Walsh and J. W. Walsh.
Foster Engineering Company, Newark, N. J.; governors, reducing valves, automatic safety stop valves, inside injector checks and reducing valves. Represented by J. M. Foster.
French Renovating Process Company, Cleveland, O.; process for cleaning car plushes. Represented by H. Stern.
French Spring Company, Pittsburgh; box lids and springs. Represented by L. C. Noble and Geo. Morris.
General Agency Company, New York; Smith triple expansion exhaust pipe. Represented by C. A. Ball, J. Y. Smith and J. R. Ellicott.
General Electric Company, Schenectady, N. Y.; photographs of motors. Represented by W. J. Clark, L. H. Parker, C. C. Pierce, F. H. Shepard and W. B. Potter.
Gold Car Heating Company, New York; system of car heating. Represented by E. E. Gold and E. H. Gold.
Goodwin Car Company, Chicago; model, drawing and photographs of the Goodwin dump car. Represented by J. M. Goodwin, G. T. Plowman and N. Seubert.
Gould Car Coupler Company, New York; freight and passenger couplers and spring buffer blocks for freight cars. Represented by C. M. Gould, Dr. C. W. Gould, A. Dowdell, W. F. Richards, F. P. Huntley and Geo. E. Widner.
Gifford Car Coupler Company, Chicago; car coupler. Represented by M. R. Clapp.
Gisholt Machine Company, Madison, Wis.; tool-grinder. Represented by F. V. Bartlett, W. H. Kruse and F. H. Robinson.
Grady, M. J., Kingston, Ont., car coupler. Represented by M. J. Grady.
Greeley & Company, E. S., New York; Acme packing waste. Represented by E. B. Eaton.
Hammett, M. C., Troy, N. Y.; Corey Force Feed Oiler, pneumatic bell ringer, guide and rod oil cups, Richardson balance valves. Represented by M. C. Hammett.
Hicks, John B., New York; Bellamy filler, R. I. Clark & Company's varnishes and japans, and New Jersey Car Spring and Rubber Company's hose, etc. Represented by J. B. Hicks and C. L. Bellamy.
Hale & Kilburn Manufacturing Company, Philadelphia; car seats. Represented by H. S. Hale, C. E. Barrett and H. T. Bigelow.
Hancock Inspirator Company, Boston; inspirators. Represented by C. E. Randall and T. Aldcorn.
Harris, E. W., Palisade, Nev.; variable exhaust nozzle.
Hodge & Company, Samuel, Detroit; McCoy sight feed lubricators. Represented by E. McCoy.
Haeseler Company, The C. H., Philadelphia; portable pneumatic tools.
Ingersoll-Sergeant Drill Company, New York; triplex, two-stage steam air compressor and 8 by 8 belt-actuated compressor. Represented by C. W. Shields.
Interchangeable Brake Beam Company, St. Louis; brake beam. Represented by J. C. Stewart and E. H. Power.
Jerome Metallic Packing Company; Jerome packing and McIntosh "duplex" blow-off cock. Represented by G. C. Jerome.
Johns Manufacturing Company, H. W., New York; asbestos fire-felt boiler and pipe covering, car roofing, paints, vulcabeston packing. Represented by F. M. Patrick.
Jenkins Brothers, New York; Jenkins 1896 valves, Sellers injectors. Represented by J. D. Stiles and C. W. Martin, Jr.
Kanaly Company, M. E., Cambridgeport, Mass.; Standard car-door hanger. Represented by M. E. Kanaly.
Kinzer & Jones Manufacturing Company, Pittsburgh; composition brake shoes. Represented by J. J. Kinzer and Wm. Weierback.
Keasbey & Mattison Company, Ambler, Pa.; magnesia boiler covering. Represented by W. W. Johnson and G. Rose.
Knitted Mattress Company, Canton Junction, Mass.; knitted mattresses. Represented by G. F. Summer.
Leach, H. L., Boston; track sander.
Lewis Tool Company, New York; vices. Represented by E. T. Leevenworth.
Look, J. C., San Jose, Cal.; unlocking lever for couplers.
Major A., New York; filter and cement.
Manning, Maxwell & Moore, Ashcroft Manufacturing Company, Consolidated Safety Valve Company, Hayden & Derby Manufacturing Company; Ashcroft steam gages, Muffler pop valves, encased locomotive valves, Tabor indicator, Metropolitan injector, and Manning, Maxwell & Moore tools. Represented by C. A. Moore, J. N. Derby, J. N. Gardner, A. C. Stebbins, R. A. Bole, D. W. Pedrick and F. T. Tapley.
Massachusetts Mohair Plush Company.
McKibben & Company, C. H., New York. Represented by C. H. McKibbin, Chas. D. Bailey, R. C. Fraser.
Moran Flexible Steam Joint Company, Louisville, Ky.; steam joint. Represented by H. U. Frankel and T. W. Moran.
More, Jones & Company, St. Louis; car and engine brasses. Represented by F. A. Johann.
Morris Box Lid Company, Pittsburgh; box lids. Represented by Geo. Morris.
Motley & Company, Thornton N., New York; the LeBel electric kindler. Represented by W. W. Caldwell.
New York Belting and Packing Company; rubber goods. Represented by A. F. Conklin.
Norton, A. O., Boston; jacks.
New York Rubber Company, New York; rubber goods. Represented by Frank Scofield.
National Malleable Castings Company, Cleveland; Tower coupler, National car-door fasteners, Eubank doors and malleable castings for cars. Represented by Willard A. Smith, C. L. Sullivan, S. L. Smith, J. V. Davison, F. R. Angell and F. B. Whitlock.
National Car Wheel Co., Buffalo; car wheels. Represented by W. W. Turlay.
National Machinery Company, Tiffin, O.; blue prints of machines. Represented by F. Bloom.
National Car Coupler Co., Chicago; the national coupler. Represented by J. Hinson.
New York Coupler Company, New York; car coupler. Represented by P. H. Wilhelm.
One-Piece Drawbar Company, Chicago; Deitz tender passenger and freight couplers and Ogden train jack. Represented by H. Deitz.
Pugh, Job T., Philadelphia; drills, augers, etc.
Peerless Rubber Manufacturing Company, New York; rubber goods. Represented by C. H. Dale, C. S. Prosser and W. J. Courtney.
Pedrick & Ayer, Philadelphia; automatic belt air compressors, air lifts, pneumatic grinding and drilling machines, pneumatic riveter, pneumatic chipping and calking tools. Represented by D. W. Pedrick, C. H. Haesler and Howard A. Pedrick.
Plush Renovating Company, Baltimore; process for cleaning plushes. Represented by Chas. H. Winkelmann and H. E. Wilkens.
Q. & C. Company, Chicago; McKee brake adjuster, Williams locomotive valve-setting device and Q. & C. flush door. Represented by C. F. Quincy, F. Ely, E. W. Hodgkins, F. E. Came and J. K. Lencke.
Railroad Supply Company, The, Chicago; the Hein double automatic coupler and car jack. Bepresented by Phil Hein, C. A. Herriman.
Reliance Replacer Company, Jersey Shore, Pa.; wrecking frogs.
Revere Rubber Company, Boston; rubber specialties. Represented by W. B. Miller, George Q. Hill, W. B. Miller, Wm. Killmer, T. A. Budd, E. Z. Jefferson, John W. Teller, George A. Gardner and Richard Kutzleb.

Ross Valve Company, Troy, N. Y., valve. Represented by Wm. Ross.

Ruth Equipment Company, Pittsburgh; sleeping-car berths with pneumatic cushions, etc. Represented by L. F. Ruth, J. B. Ruth and George Miller.

Star Brass Manufacturing Company, Boston; track sanders, pop safety valves, steam gages, whistles, air-brake and inspector's gages. Represented by C. W. Sherburne and E. C. Sawyer.

Safety Car Heating and Lighting Company, 160 Broadway, N. Y.; the Pintsch light. Represented by A. W. Soper, Robert Andrews, R. M. Dixon, M. P. Stevens, E. F. Slocum and O. C. Gayley.

Sewall, J. H., Worcester, Mass; "Standard" brake slack adjuster.

Shickle, Harrison & Howard Iron Company, St. Louis; cast-steel body and truck bolsters. Represented by T. M. Gallagher.

Sams Automatic Car Coupler Company, Denver, Col.; model couplers on model cars. Represented by C. G. Burkhardt and L. D. Sweet.

Smith & Company, Edward, New York; preservation of metal surfaces. Represented by A. Johnson and E. H. B. Twining.

Standard Steel Works, Philadelphia; locomotive tires, steel tired locomotive and car wheels. Represented by M. Middleton, C. Riddell and T. L. Courtney, Jr.

Springfield Malleable Iron Company, Springfield, O.; Miner and Bryan draft rigging and the Ludlow freight, passenger and tender couplers. Represented by R. Ludlow, J. T. Ricks and A. Ludlow.

Schirra Seal Company, Pittsburg; car seals. Represented by Schirra and G. Fivel.

Schoen Pressed Steel Company, Pittsburg, Pa.; pressed steel bolsters. Represented by C. T. Schoen and J. T. Milner.

Smillie Coupler Company, Newark, N. J.; car coupler. Represented by C. H. Taylor.

Smart Car Door Company, Nashua, N. H.; flush car door. Represented by H. D. Smart.

Taylor Iron & Steel Company, High Bridge, N. J.; Taylor steel tired wheels. Represented by W. J. Taylor.

Taylor Company, N. & G., Philadelphia, tinplate and Pancoast ventilator. Represented by M. J. Cusick.

Tilden Company, B. E. Chicago; wrecking frog. Represented by B. E. Tilden.

Trojan Car Coupler Company, Troy, N. Y.; car coupler. Represented by A. H. Renshaw, H. N. Loomis, W. C. DeArmond and E. Dietz.

Universal Construction Company, Chicago; Harvey and Pennock steel cars. Represented by W. R. Stirling.

Universal Safety Car Bearing Works, Jersey City, N. J.; Baker's universal safety car bearings. Represented by J. R. Baker.

Vose & Cliff Manufacturing Company, New York; King's yielding side bearings. Represented by E. Cliff.

Whitman & Company, Clarence, New York; Pantasote, a substitute for leather. Represented by H. E. Twining and H. M. Grier.

Western Railway Equipment Company, St. Louis; Houston locomotive track sander, combination lug and follower, economy slack adjuster and American journal box. Represented by E. S. Marshall.

Wilson & McIlwain, Pittsburg; Clancy's hose clamp, Wadsworth, Howland & Company's paints, Wells lights, Keystone soft metal unions, Sewall's brake slack adjuster, and Hutchins' roof. Represented by J. T. Wilson and J. D. McIlwain.

Wolstencroft's Sons & Company, Wm., Philadelphia; pneumatic hammers. Represented by G. B. Harris and Wm. H. Curtis.

Yerdon, Wm., New York; double hose band. Represented by Wm. Yerdon.

Zenner-Raymond Disinfectant Company, Detroit, Mich.; disinfectant. Represented by A. H. Zenner.

Souvenirs at the Conventions.

As usual, there were a number of souvenirs distributed at the conventions. We only have room to publish a list of them, without attempting descriptions, though many of them are worthy of praise:

American Brake Company, St. Louis; views of the destruction wrought by the St. Louis tornado.

Boston Belting Company, Boston; glass paper weights, pen wipers and whist counters.

Brown Hoisting and Conveying Machine Company; pass books.

Brown & Sharpe, Providence, R. I.; three-inch scales.

Buckeye Malleable Iron and Coupler Company, Columbus, O.; pocket knives.

Ewald Iron Company, St. Louis; paper cutters.

Flood & Conklin Company, Newark, N. J.; pocketbooks.

Foster Engineering Company, Newark, N. J.; trick match safes.

Jenkins Brothers, Jersey City, N. J.; whist counters.

Morris Box Lid Company, Pittsburgh, Pa.; corkscrews.

National Machinery Company, Tiffin, O.; match safes.

Peerless Rubber Manufacturing Company, New York; pocket knives.

Pocket List of Railroad Officials, 326 Pearl street, New York; 12-inch folding steel rules.

Pratt & Lambert, 47 John street, New York; note books with aluminum covers.

Revere Rubber Company, Boston; glass paper weights.

Safety Car Heating and Lighting Company, 160 Broadway, New York; card cases.

Smillie Coupler & Manufacturing Company, Newark, N. J.; note books.

Standard Paint Company, 81 John street, New York; note books.

T. Prosser & Son, 15 Gold street, New York; playing cards.

W. W. Laurence & Co., Pittsburgh, Pa.; lead pencils in the form of a hollow nail containing adjustable leads.

AMERICAN RAILWAY MASTER MECHANICS ASSOCIATION.

Abstracts and Summaries of Reports Presented at the Twenty-Ninth Annual Convention.

Exhaust Pipes and Steam Passages.

ROBT. QUAYLE, WM. FORSYTH, J. MCNAUGHTON, W. S. MORRIS, D. L. BARNES, PROF. W. F. M. GOSS, Committee.

The work was outlined by the committee, as follows:

First. Determine the angle of the exhaust steam jet.

Second. The effect of the shape of the orifice on the angle and shape of the jet.

Third. Determine the effect of height of bridge on the direction of the individual jet.

Fourth. Vary height of nozzle with best form of orifice and height of bridge, as determined by tests two and three, from the highest to the lowest practicable point, with the form of stack recommended by last year's committee.

Indicator cards to be taken to also determine the effect of change of form of orifice on the back pressure in the cylinder.

Fifth. Vary the length of the stack recommended by last year's committee, with nozzle located at the most efficient point as determined by the fourth test.

Sixth. Vary the heights of straight stack that last year's committee recommended, nozzle located the same as in fifth test.

Seventh. Vary the size of the nozzle with the best arrangement of parts, as already determined.

Eighth. Comparative results of double and single nozzles.

It was agreed that work under the first three points should be undertaken in connection with the locomotive testing plant of Purdue University, at Layfayette, Ind., and that the remainder of the work should be done in connection with the testing plant of the Chicago & Northwestern Railway, at West Chicago shops. This division gave to the Purdue University the study of the form and density of the exhaust jet (Part I), and to the Northwestern the study of its efficiency, as effected by all the various changes suggested by the outline (Part II).

PART I.

FORM AND CHARACTER OF THE EXHAUST-STEAM JET.

The methods employed in this study and the apparatus used were practically the same as described by Professor Goss before the Western Railway Club, in October, 1895, in his paper, "A Glimpse of the Exhaust Jet." The conclusions from these investigations are given by the committee as follows.

1. The action of the exhaust jet within the stack is not that of a piston within the barrel of a pump.
2. Draft can as well be produced by a steady flow of steam as by the intermittent exhaust jet.
3. The exhaust jet, under ordinary conditions, does not fill the stack until near its top.
4. The vacuum within the stack at points near its base is greater than that within the smokebox.
5. The jet acts upon the smokebox gases in two ways; first, by frictional contact it induces motion in them, and second, it enfolds and entrains them.
6. In all jets examined the induced action was relatively strong and the entraining action weak.
7. Any condition which will tend to solidify or to reduce the spread of the jet appears to affect favorably its efficiency.
8. Changes in stack proportions may greatly affect the form of the jet.
9. In general, a change in the amount of steam discharged will change the form of the jet, the spread being reduced as the volume of steam is increased.
10. Other things being the same, the form of the jet is not much affected by changes in speed or of cut-off.
11. The form of the nozzle has much to do with the form of the jet, and hence with its efficiency.

The experiments of the committee disprove the pump-action theory of the exhaust. They show that the jet of steam does not fill the stack at or near the bottom; that under certain conditions common to practice it touches the stack only when it is very near the top; and finally, that a jet of steam flowing steadily from the exhaust tip, the engine being at rest, results in draft conditions which are in every way similar with those obtained with the engine running, the same amount of steam being discharged per unit of time in each case. These facts will doubtless be accepted as proof of the statement that the smokebox gases are not forced out by the action of the steam jet.

Enough has not yet been done to define the precise action of the jet, but it may be said with certainty (1) that it acts to induce motion in the particles of gas which immediately surround it, and also (2) that it acts to enfold and entrain the gases which are thus made to mingle with the substance of the jet itself.

It is clear that any design of nozzle which will serve to subdivide the stream, or to spread it so as to increase its cross-section, will assist the jet in its effort to entrain the gases, but it is not clear that there is any gain to be realized in such a result. It is possible that, as the mixing action is increased, the induced action may be diminished, and that the sum total of the effect produced may remain nearly constant. The work which has thus far been done is not conclusive on this point, but the evidence tends to show that the more compact and dense the jet, the higher its efficiency.

Interesting diagrams of the form of the exhaust jet at different speeds, with various nozzles, and several different inside diameters of stacks are presented by the committee. A comparison of the form and location of similar lines in different jets shows the effects produced by the different combinations of pipes, nozzles, etc.,

which were experimented upon. While making such a comparison, it is of interest to remember that a vacuum gage attached to the side of the stack at a point 13 inches above its base always gave about one and one-half (1.5) times the vacuum recorded by the smokebox vacuum gage; and that a second gage attached within 10 inches of the top of the stack gave a vacuum approximately equal to six-tenths (0.6) of the vacuum in the smokebox. The diagrams show that increased speed results in less spreading of the jet, and a better vacuum, but the latter is due to the greater volume of steam passing, and not to the rapidity of the exhaust impulses.

By blocking the slide valves clear of their seats and opening the throttle slightly the committee were enabled to cause a steady blow through the exhaust in which the weight of steam passed was practically the same as in some of the trials of the regular jet. The results, as already stated, show that there is no essential difference in the effects of the two kinds of jets.

The portion of the exhaust pipe above the top of the bridge serves to combine and to straighten the jet. The lower the bridge the greater the length of this combining or straightening pipe, and a more dense and compact jet is delivered from the nozzle. A nozzle ending in a plain cylindrical portion two inches in length gave better results than either a nozzle contracted in the form of a frustum of a cone, or a nozzle in the form of a plain cylinder ending in an abrupt cylindrical contraction, the jet from the first-named nozzle being more solid and efficient.

A false "chock," reducing the diameter of the stack from 16 inches to 12 inches, widens the angle of the lower part of the jet, the outer walls of which it especially affects. The chock acts as a throttle on the delivery of the combined stream of gases, and by so doing produces a material reduction in the velocity of currents of gas and steam within the smokebox for points about the jet and immediately below the stack; this reduced velocity allows the steam jet to "upset," or broaden.

PART II.

These tests were made on the Chicago & Northwestern testing plant at the West Chicago shops, with engine 797, a ten-wheel Schenectady locomotive, with 19×24 inch cylinders, 56-inch driving wheel centers, having an eight-foot firebox, 40¾ inches wide, located on top of the frames. The engine was fitted with five draft gages, two at the smokebox and three at the firebox; a Boyer speed-recorder; two Bristol recording gages, one showing the boiler pressure, and the other connected to the exhaust cavity in the left cylinder saddle. Indicator cards were taken from both cylinders, those from the left side being taken with a 100-pound spring, while on the right side a 10-pound spring was used and the piston provided with a stop at 20 pounds in order to show the back pressure accurately. Constant conditions in the firebox could not be obtained with coal and the grate was therefore blocked with firebrick except an opening of about 189 square inches, and petroleum used for fuel.

The actual work performed was not exactly that outlined by the committee, as more work than was anticipated was found to be necessary to determine the best features of the design of an exhaust pipe, and, in consequence, some of the work on stacks as outlined in parts five and six was not reached.

The work on this testing plant relates principally to the proper design of an exhaust-pipe and nozzles for maximum efficiency, and the results obtained are believed to confirm the following conclusions, all of which are established only within the limits of the experiments, and for the arrangement of smokebox, boiler and flues used in the tests:

First. The exhaust-pipe should be as short as possible with a proper arrangement of diaphragm and netting, provided this does not make it less than 19 inches high, which was the lowest limit tested.

Second. The bridge in this pipe should not be less than 13 inches high.

Third. The area of each of the openings of the pipe at the most contracted part should be not less than the area of the nozzle. (This conclusion may only be true for the pareicular form of pipe and location of the choke used in the above experiments.)

Fourth. When it is necessary to reduce the area of the exhaust opening, it should be done at the nozzle and not at the choke.

Fifth. The nozzle should be raised when necessary by lengthening the portion of the pipe above the top of the bridge, rather than below.

Sixth. The exhaust tip ending in a plain cylindrical portion 2 inches in length in these tests gives better results than either a nozzle contracted in the form of a frustrum of a cone or a nozzle in the form of a cylinder with an abrupt cylindrical contraction at the orifice.

Seventh. The distance from the choke of the stack to the nozzle for 14-inch choke stack 52 inches long should not exceed 50 inches, nor be less than 40 inches for maximum efficiency.

Eighth. The distanee from the top of the smoke arch to the nozzle with 14-inch straight stack 52 inches long, should not be greater than 38 inches nor less than 23 inches.

Ninth. The distance from the top of the smoke arch to the exhaust nozzle, with a 16-inch straight stack 52 inches long, should not be greater than 38 inches nor less than 28 inches.

Tenth. The efficiency of the steam jet is reduced by spreading it by means of cross bars in the nozzle.

Eleventh. Cross-bars not wider than ⅜-inch placed in the nozzle or above it nearer than 1 inch increase the back pressure; wider cross-bars increase the back pressure when further removed in proportion to their width.

Twelfth. A petticoat pipe with the single nozzle, when properly arranged, increases the efficiency of the jet.

Thirteenth. Double nozzles, with 14-inch choke stack and 16-inch straight stack 52 inches long, are not as efficient as single nozzles, the difference being very slight.

Fourteenth. Double nozzles should be located with reference to the stack the same as single nozzles.

Conclusions from the Von Borries-Troske tests (see AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL for March and May, 1896) on the effect of various lengths of conical and cylindrical stacks.

Fifteenth. The maximum height of stack, measured from the exhaust nozzle, if the diameter at the choke is properly chosen, need not exceed five times this diameter. For cylindrical stacks the ratio of diameter to height is the same.

Sixteenth. The vacuum increases as the stack is shortened and more rapidly with cylindrical than with conical stacks.

Seventeenth. The decrease in vacuum due to shortening the stack within certain limits can be nearly overcome by lowering the nozzle. The amount which the nozzle should be lowered with cylindrical stacks is almost equal to the amount the stack is shortened. With conical stacks the nozzle should be lowered about two-thirds as much as the stack is shortened.

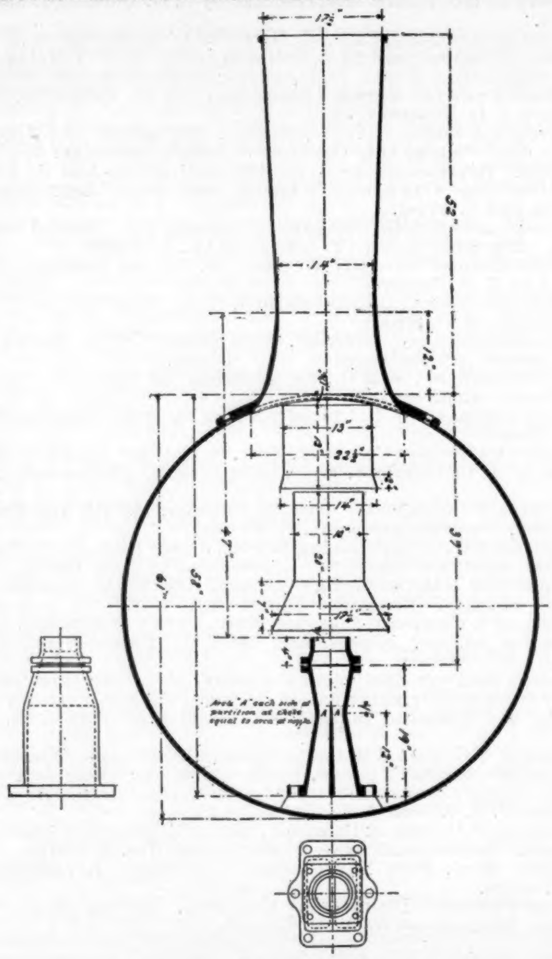


PLATE 48.

Plate 48 shows the arrangement of exhaust pipe, nozzle, petticoat pipe and stack, which gave the best general results as to vacuum and efficiency in the committee's tests. An inspection of the results of the tests in Part II. will show that certain variations from the above change but slightly the effectiveness of the draft appliance. The limits within which the different parts experimented with can be changed without materially affecting the efficiency of the apparatus as a whole are as follows:

First. Height of the bridge should not be lower than that shown, although lowering it decreases the efficiency but little.

Second. Distance of the nozzle from the choke of the stack can be from 49 inches to 39 inches, preferably nearer the former than the latter.

Third. The area of each opening at the choke of pipe can be decreased below the area of the nozzle as much as 20 per cent., without greatly decreasing the efficiency at speeds and cut-offs experimented with. Preference to the larger opening should be given with engine working generally at short cut-offs.

Fourth. The petticoat pipe can be made to considerably increase the efficiency of the draft apparatus in boilers of this diameter and probably larger, but it must be carefully adjusted to the exact draft conditions of the engine. This can probably only be done with the engine in actual service. In boilers of smaller diameter, a petticoat pipe is probably of little or no service. The committee's tests are not sufficiently comprehensive to give the limits of this adjustment. They indicate, however, that the top of a 13-inch top section should not be higher than 2 inches below the top of the smokebox with 14-inch choke or 16-inch straight stack.

Fifth. The 14-inch choke stack could probably be shortened without materially affecting the vacuum. By how much, the committee's tests do not show. A straight stack must be larger than 14 inches diameter, but neither 14-inch nor 16-inch straight stacks give as good results as the choke stack, although the 16-inch straight stack shows much better results than that 14 inches in diameter.

Slide Valves.

G. R. HENDERSON, W. H. THOMAS, E. E. DAVIS, PHILIP WALLIS, L. R. POMEROY, Committee.

Your committee on "Slide Valves" was given two problems to solve: 1st, To consider different types of balanced valves, and to determine their economy and efficiency over plain unbalanced valves; and 2d, To determine the economy and efficiency of Allen ported valves over plain valves.

BALANCED VALVES.

This report will deal only with such styles of balanced valves as are now in actual service on railroads. From the replies to the circular of inquiry (constituting only 52 out of the total membership of over 600) we find that of 10,934 locomotives on 50 roads, 7,241 are equipped with balanced valves of some type, and that 145 have piston valves, the latter mostly on compounds. The balanced valves are distributed about as follows:

Richardson	5,915	Delaney	42
Morse	482	Margach	30
Barnes	288	Leeds	8
American	287		

In regard to the amount of balance used on the valves, there was a great variety in the statements, which ran from 48 per cent. to 95 per cent. of the total valve area, though the greatest number, by far, gave between 55 per cent. and 65 per cent. of the total valve area.

The valves tested by your committee had balance areas as follows.

	Square inches.	Per cent.
Richardson valve	97.95	56
Sin bal. American	99.40	61½
Double bal. American	106.90	66

It should be borne in mind, however, that the taper of the American rings, with steam pressure on the outer circumference, will tend to force the valve down on the seat, overcoming in part the much larger balancing area.

The answers to the question relative to the wear of seats and valves per unit of distance indicated that a wear of from $\frac{1}{32}$ inch to $\frac{1}{16}$ inch per 100,000 miles might be expected with balanced valves, with from two to three times as much for unbalanced valves, while the wear on the link motion varied in about the same proportion.

The expressions in regard to piston valves were all favorable with one exception, this being with a road with five compound locomotives with piston valves.

The different styles of balanced slide valves may be brought down, generally, to two types, viz: Those whose balanced area is enclosed by straight strips, and those who balanced area is enclosed by circles.

It was decided that the Richardson and the American valves could well be taken to represent the two types. One single-balance and one double-balance American valve were tested at Purdue University, and one Richardson valve—the strips were afterward removed from this, the hole in crown plugged, and it was then used as a plain unbalanced valve.

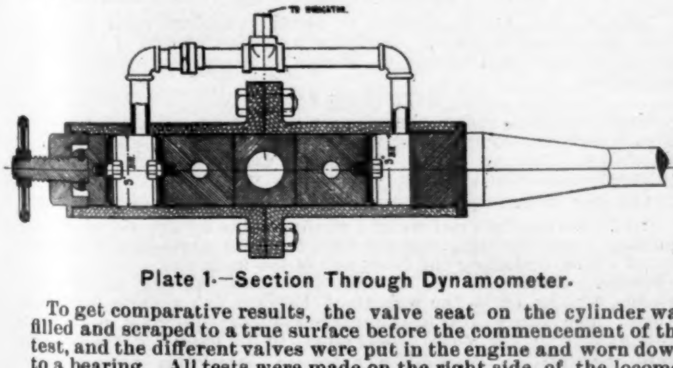


Plate 1.—Section Through Dynamometer.

To get comparative results, the valve seat on the cylinder was filled and scraped to a true surface before the commencement of the test, and the different valves were put in the engine and worn down to a bearing. All tests were made on the right side of the locomotive, and in the forward motion only. The valves used were all new.

In order to measure and record the force necessary to move the valves a dynamometer (see Plate 1) was connected by a hinged pipe with an ordinary indicator, the motion of the drum being taken from the valve stem. While this dynamometer was rather a crude affair and not one that the Committee would recommend for accurate work, on account of the variable friction of the leathers and the method of taking up the water used by the indicator, yet it was the best that the Committee could obtain, and every effort was made to secure results that could at least be comparable. The dynamometer and the indicator gave one inch height on the diagrams for 800 pounds on the valve stem. Steam chest and cylinder diagrams were taken simultaneously and a large and regular flow of oil from the lubricator was maintained. In the friction tests about 150 miles were run and over 600 cards taken in this and the Allen port experiments.

It was decided to work in the first, eighth, eleventh, thirteenth and fourteenth notches, and at speeds of 10, 20 and 40 miles per hour, and as these notches gave cut-offs of 21¾, 18¼, 14¼, 9¼ and 6½ inches respectively, it was believed that the range was sufficient.

In order to explain the different curves of the friction diagrams obtained the unbalanced diagram at first notch and 20 miles per hour, is reproduced on Plate 2, as a representive type of the set. The difference in height between the forward and backward strokes is due to the steam pressure on the area of the valve stem, which resists forward motion, and assists backward. This is shown by the shaded area (see Fig. 1).

The lines *a—b* and *c—d* (Fig. 2, Plate 2) show the load resulting from the inertia of the parts. As far as the friction of the valve is concerned, there must also be a correction for inertia. In order to show the valve friction, free from the effects of inertia and the area of valve stem, Fig. 3, Plate 2 has been constructed, correction having been made for both of these points. This enables one to analyze the valve friction at various points of the travel, by placing under the diagrams a section of valve and seat, and moving the valve to the various positions. This curve (Fig. 3) is for the backward stroke only, and the analysis appears in Fig. 4, reference being made to several letters.

A corresponds to the extreme front end of travel, and at *B* the full pressure is registered on the indicator at the end of the pipe, and the curve falls from the friction of rest to the friction of motion. From *C* to *D* the valve becomes partly balanced by the portion overhanging steam port *N*, and reduces the friction. From *D* to *E* port *N* closes, the steam expands, reducing the balance, and the friction rises slightly. From *E* to *F* the steam in port *N* expands more, slightly increasing the friction. From *F* to *G* compression begins in port *M*, increasing the balance and diminishing the friction slightly. From *G* to *H* the steam in port *N* is exhausted, diminishing the balance and increasing the friction. From *H* to *I* the admission of steam in port *M* increases the balance and the friction drops, and from *I* to *J* the valve moves from off port *M* and the friction increases. From *J* to *K*, the end of travel, the conditions remain nearly constant.

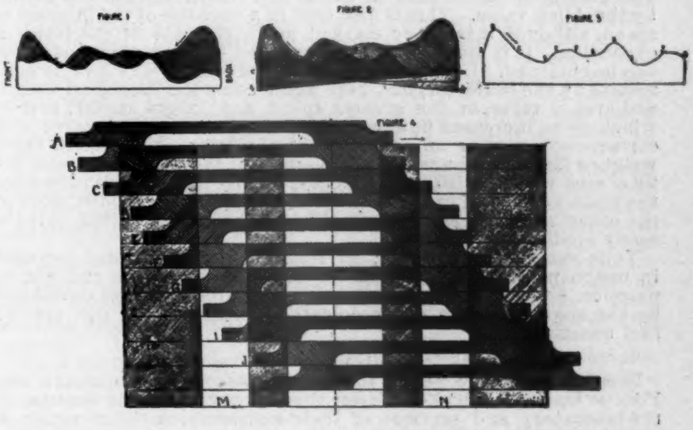


Plate 2.—Diagrams from Dynamometer.

It would require too much time and space to thus analyze all the diagrams, but those who wish to study the effects closely can proceed as indicated above.

The committee found it was unable to determine the stuffing-box friction, but this would probably be constant. It is found that the unbalanced valve requires twice as much work to move it as the balanced valves, and your committee believes that this will represent the average results in ordinary railroad practice. Of course, by balancing a large area, the friction could be still further reduced, but the danger of the valves lifting off its seat would be rather great. Your committee, therefore, recommends the following rule for balancing slide valves:

Area of balance = area of exhaust port + area of two bridges + area of one steam port.

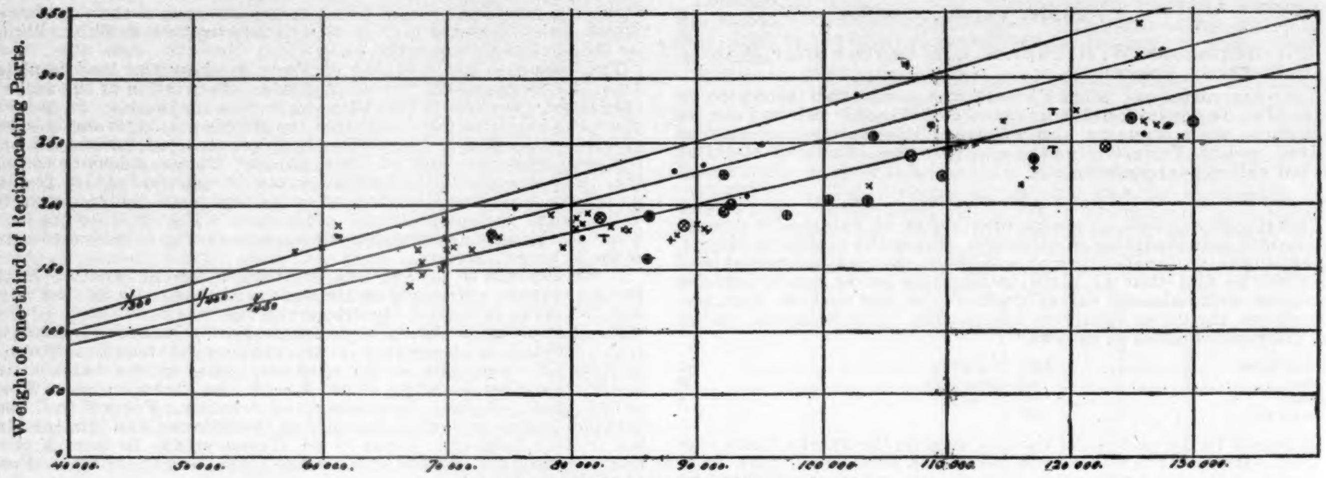
The above is to obtain for both Allen and plain valves.

Your committee had hoped to be able to give the results of some experiments with a piston valve on a simple locomotive but were not able to do so.

ALLEN VALVES.

The responses to the circular developed the fact that of 10,934 engines on 50 roads, 513 were equipped with the Allen ported valve. Incidentally, it may be mentioned that all but one were balanced. The great majority are used in passenger service only, though several advised that they made no distinction in the use of this type of valve. It also appeared that in some cases an engine with an Allen valve was given one or two more cars than an engine with a plain valve, and also that less lead was used. While the majority of replies showed that the Allen valve was satisfactory and especially advantageous at light speeds and early cut-offs, yet a few condemned the valve as having no advantage over the plain type. Some have substituted long ports in place of the Allen valve, one case of which your committee knows, having used ports 23 inches long on a 19 × 24-inch cylinder. This was to obviate the breaking and imperfect coring of the Allen valve.

In order to obtain strictly comparable indicator cards, a false seat was prepared to take an Allen valve with the same elements and motion as the plain valve. The runs were made in the 1st, 8th, 11th, 13th, 14th and 15th notches, and at speeds of 10, 20, 30, 40, 50 and 60 miles per hour, as far as it was possible to obtain them. As might have been expected, the indicator cards show that the mean effective pressure with the Allen port is greater than without it at the ordinary running positions. The average shows 20 per cent. in favor of this valve. Of course it must not be concluded that this 20 per cent. will be gained without an increase in fuel, for from the nature of the argument it has been shown that more steam is admitted to the cylinders, and hence more fuel is necessary, but it can be considered that the Allen port has enabled the piston to exert 20 per cent. more useful pressure on the crosshead for each stroke. It is



Weight of Engine in Working Order.

Locomotive Counter-Balancing.—Fig. 1.

also readily apparent that the earlier the cut-off the more is gained by the Allen valve. This is also true in a measure of the increase of speed, although it is not so marked as in the case of the ratios of expansion. It is also clearly demonstrated that a better steam line can be obtained. Long ports, or increased travel, may give us good results by the indicator, but here again come the increased weight and area of valve, or the greater speed and longer stroke, both of which mean increased power absorbed in moving the valve with corresponding wear on seat and link motion. This Allen valve weighed 125 pounds, against 85½ pounds for the plain valve, and the total area was only 190 square inches, against 161¼ square inches for the plain valve, and in the case of an engine already built, both of the other methods seem impractical, whereas the Allen valve is easily applied.

Your committee, therefore, believes that this 20 per cent. increase in piston power, due to the Allen valve, can often be realized in practice, and that it must certainly mean greater power developed by the engine, though not necessarily greater power per unit of fuel consumed.

CONCLUSION.

In concluding this paper your committee desire to thank the Purdue University and Professor Goss in particular for the use of the laboratory and services of their assistants, without which it would have been difficult to proceed with the work. Mr. Wilson, of the American Balance Slide Valve Company, also deserves the thanks of the committee for furnishing two valves and steam-chest covers and valuable assistance at the tests, and the same remarks apply to Mr. Hammett, who furnished two Richardson valves and the false seat, as well as doing much hard work with the committee at Purdue. They also wish to express the indebtedness due the Schenectady Locomotive Works for the new steam chest and studs, the Lehigh Valley Railroad for furnishing the dynamometer, and the Norfolk & Western Railroad for the various yokes and rods, and the use of the valve motion indicator.

Counter-Balancing Locomotives.

E. M. Herr, W. H. Lewis, C. H. Quereau, S. P. Bush, Committee.

Your committee have formulated the rules which follow, after full consideration of the following fundament principles:

First. The weight of the reciprocating parts that are left unbalanced should be as great as possible, consistent with a good riding and smooth-working engine.

Second. The unbalanced weight of the reciprocating parts of all engines for similar service should be proportional to the total weight of the engine in working order.

Third. Total pressure of the wheel upon the rail at maximum speed when counter-balance is down must not exceed an amount depending upon the construction of bridges, weight of rail, etc., and when counter-balance is up the centrifugal force must never be sufficient to lift the wheel from the rail.

A majority of railroads answering the committee's circular leave unbalanced one-third of the reciprocating parts. In order to see how nearly this method makes the unbalanced weight of the reciprocating parts proportional to the total weight of the engine, we have plotted on Fig. 1 the relation of the unbalanced reciprocating weight on one side and the total weight of 75 road engines in acual satisfactory service on seven different roads. On the same diagram are drawn lines, all the points in which are proportional to the total engine weights laid off on the horizontal. The first line marked $\frac{1}{450}$ is drawn through about the average of all the points plotted, and indicates that the average unbalanced weight of the reciprocating parts on one side of engine as balanced on these roads is $\frac{1}{450}$ of their total weight. The upper line marked $\frac{1}{360}$ represents the ratio of unbalanced reciprocating parts on one side to the total engine weight, recommended by Mr. G. R. Henderson, Mechanical Engineer of the Norfolk & Western Railroad, in an admirable report on this subject made to Mr. R. H. Soule, about a year ago and to which your committee is indebted for valuable data and suggestions. Mr. Honderson proposes the following formula for expressing the relation between the unbalanced reciprocating parts and the total weight of the engine:

$$Wr = \frac{Wt}{360}$$

Wr = the weight of the unbalanced reciprocating parts on one side.

Wt = the total weight of the locomotive in working order.

From the data obtainable, we believe this formula allows a greater proportion of the reciprocating parts to remain unbalanced than present good practice will warrant.

The intermediate line marked $\frac{1}{400}$ on diagram indicates the average maximum of unbalanced weight of reciprocating parts in locomotives now in service on various roads. From actual tests of locomotives so balanced in fast passenger service, we recommend it as a safe formula for the maximum limit of the weight of the unbalanced proportion of the reciprocating parts on one side.

In formulating the following rules it is assumed that the driving wheels are finished and mounted on their axles with pins in place.

In designing new locomotives the proper counter balance weight should be calculated and cast into the wheel centers as follows: Place the center of gravity of counter-weight opposite the crank-pin as far from the wheel center as possible and have it come as near the plane in which the rods move as proper clearance will allow. To obtain weight of the reciprocating parts and detachable revolving parts, proceed as follows:

RECIPROCATING PARTS.

Take the sum of the weights of piston complete, with packing ring, piston rod, crosshead complete, and the weight of the front end of the main rod complete. Weigh each end of rod separately supported.

REVOLVING PARTS.

Weigh the back end of the main or connecting rod, and each end of each side rod complete, separately supported. The sum of the weights so found which are attached to each crank pin are the revolving weights for that pin.

RULES FOR COUNTER-BALANCING LOCOMOTIVE DRIVING WHEELS.

First. Divide the total weight of the engine by 400; subtract the quotient from the weight of the reciprocating parts on one side as found above, including the front end of the main rod.

Second. Distribute the remainder equally among all driving wheels, adding to it the weight of the revolving parts for each wheel. The sum will be the counter-balance required if placed at a distance from the wheel center equal to the length of the crank.

SHOP METHOD OF COUNTER-BALANCING MOUNTED LOCOMOTIVE DRIVING WHEELS.

Place the axle with journals upon the straight edges and level the straight edges by means of the adjustment screws. Turn the wheels until the center of one crank pin is above and exactly in a vertical line drawn through the center of the axle. Hang a yoke on the opposite pin; then add weights until the sum of the weight of the yoke and weights equals the exact weight of all the detached revolving parts on this wheel, plus the proportion of the reciprocating weights determined by rules given above. Increase or decrease the counter-balance opposite the crank pin until it exactly balances the weight thus applied. Repeat this process for the opposite wheel in the same manner.

Counter-balance weights added to old wheels should be generally cast in two parts, fitted between spokes, securely bolted, with the ends of bolts riveted over the nuts. Increased weight of counter-balance can be obtained when necessary by boring out cast iron and substituting lead, or in other ways replacing cast iron with a denser material.

CAUTIONS AND LIMITATIONS.

If we assume that the maximum speed in miles per hour of the driving wheel of a locomotive equals its diameter in inches, it can easily be shown (see appendix) that if such wheel is overbalanced by an amount W, at its maximum speed, this overbalance will increase and decrease the wheel pressure on the rail each revolution 38.4 times W, or denote such increased pressure by P, then P = 38.4 times W, or nearly $P = 40\ W$. Therefore, in order that the wheel

shall never leave the rail, 40 times the portion of the weight of the reciprocating parts added to each wheel must not exceed its static pressure on the rail. To insure safety it should not exceed 75 per cent. of such pressure. Nor should this amount, when added to the static wheel pressure, exceed the safe maximum pressure allowed on track and bridges. Locomotives with rods disconnected and removed should not be hauled at high rates of speed.

Make reciprocating parts as light as possible.

Spread cylinders as little as possible.

The committee recommends that a number of roads be selected to try the rules outlined, and report result of the trial before the convention of 1897; and that the committee be continued until that time, when, if the practice is found satisfactory, it can be adopted as standard.

APPENDIX.

We take the following from Mr. Henderson's report:

"To determine the centrifugal force, we have from Weisbach, Vol I., page 609, the following formula:

$P = .00034\, U^2 G R$
U = revolutions per minute.
G = weight in lbs.,
R = radius in feet. Now let
s = speed in miles per hour;
d = diameter of wheel in inches, then

$$U = \frac{s \times 5280 \times 12}{3.1416 \times d \times 60} = \frac{s \times 1056}{d \times 3.1416} = 336 \frac{s}{d}$$

and

$$U^2 = 112896 \frac{s^2}{d^2} \text{ and, substituting, we have,}$$

$$P = 38.4 \frac{s^2}{d^2} G R \qquad \text{and where } R = 1,$$

$$P = 38.4 \frac{s^2}{d^2} G$$

If we assume that the speed in miles per hour at its maximum equals the diameter of the wheel in inches, we have simply

$P = 38.4\, G$, or say, $P = 40$ G.

Steps and Handholds.

JOHN MEDWAY, H. BARTLETT, J. T. GORDON, F. M. TWOMBLY, G. H. BAKER, Committee.

The majority of those answering the circulars of the committee are in favor of a wide double step on the front corners of the tender frame and long vertical grab irons, or handholds, on the front corners of tanks, on the back of cabs and in connection with the cab brackets. A few persons favor a wide step on the back corners of engines also. The form of steps used extensively on modern locomotives usually contains too deep an opening in the riser. This feature the committee considers an element of danger in that the foot is liable to slip through. They recommend that the distance between the tread and opening be not less than five inches. The step recommended by them is shown in Fig. 1. They do not advocate steps at the back corners of tenders. For switching-engines they recommend long steps suspended transversely from the back of the tender frame. The step should have a back guard to prevent the foot from slipping through. It should be made and applied in a substantial manner and set at the uniform height of 12 inches from the rail. Care should be taken to leave an opening between the tread and riser sufficient to dispose of ice and snow, but not large enough to admit a part of the foot. In connection with this

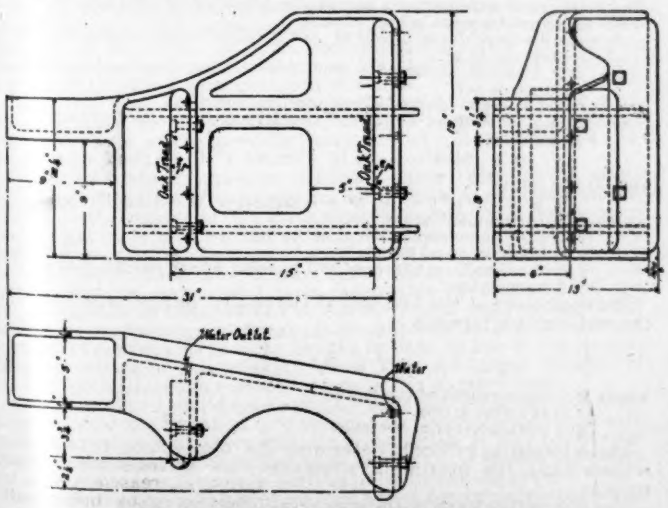


Fig. 1.—Recommended Tender Step.

step, a long, horizontal hand-rail should be placed at a convenient height. On road engines various kinds of steps or ladders are used with which to reach the top of tank at back.

Headlight steps should have a roughened tread and flanges on the sides, and should be applied to the smokebox at a convenient point between the steam chest and headlight. A supplemental hand rail should be provided, and sometimes a pilot step is necessary. But the details must be governed by conditions that vary too much to permit of a general rule. To reach sand boxes, steps similar to those on the smokebox are satisfactory.

In conclusion, the committee is of the opinion that to insure comparative safety the form and location of locomotive steps and handholds should be so nearly uniform that in mounting or alighting one could, even in the dark, readily locate with his feet and hands all the steps and handholds of any locomotive.

Cylinder Bushings.

J. N. BARR, J. H. McCONNELL, J. S. CHAMBERS, GEO. F. WILSON, W. H. MARSHALL, Committee.

The conclusions of this committee are summarized as follows:

First. That cylinder bushings ½ inch to ¾ inch in thickness will meet all requirements.

Second. The bushings should be turned to the same diameter as the cylinder fit.

Third. Bushings of a uniform outside diameter and extending from the back to the front cylinder head, or bushings extending from the back steam port to the front head, the bearing surface of the cylinder heads resting partly on the end of the bushing and partly on the cylinder proper, without any fastening except the pressure of the heads, will give perfectly satisfactory results.

Fourth. The use of bushings is a practical method of reducing the bore of cylinders, of repairing cracked and worn cylinders, and avoiding the difficulty of cylinders which are too soft.

Fifth. The question of fuel and oil economy, which may be obtained by the use of hard, homogeneous bushings, is one which should receive careful attention.

Those recommending the use of bushings for new cylinders do so on the following considerations: The qualities required in a cylinder casting in order to withstand the strains to which it is subjected are especially strength and toughness. These two qualities are, however, inconsistent with the hardness that is necessary to secure a good, smooth polish in the bore of the cylinder. In the attempt to obtain a good wearing surface in the cylinder, the casting has a tendency to become of such a character as is liable to crack in service.

By the use of an independent bushing a perfectly clean casting of uniform density throughout, and of such a hardness as will give the best results as to wear can be obtained without in any manner influencing the quality of the material in the body of the cylinder.

It should be borne in mind that frictional resistence between the cylinder and the piston consumes a large amount of power, and any means which will reduce this resistance is likely to produce a freer working engine, and one more economical in consumption of fuel and oil.

Some members of your committee are decidedly of the opinion that the advantages gained by using a brushing harder than it is possible to obtain in the ordinary cylinder casting effect a decided economy in the above respects.

In this connection your committee desire to call attention also to the matter of false valve seats. If these are cast separately, they can be made much harder than the ordinary solid seat. The false seats are now constructed in such a way as to give practically no trouble, and with the adoption of the false valve seats, and a cylinder bushing of the proper hardness, the entire wearing parts of the cylinder would be fully provided for, and the failure of the cylinder would simply depend on its power of resisting the strains to which the body is subjected in service.

Standard Size of Boiler Tubes.

WM. SWANSTON, Committee.

The committee recommends that the standard specifications for locomotives iron boiler tubes be changed to conform to the decimal gage of the association and to allow additional thickness at the weld by being made to read as follows: Under the head "Dimensions and Weight."

TUBES 2 INCHES OUTSIDE DIAMETER.

.095	inches thick	and	weight at least	1.01	pounds	per foot.
.110	"	"	"	2.19	"	"
.125	"	"	"	2.47	"	"
.135	"	"	"	2.65	"	"

TUBES 2¼ INCHES OUTSIDE DIAMETER.

.095	"	"	"	2.16	"	"
.110	"	"	"	2.48	"	"
.125	"	"	"	2.80	"	"
.135	"	"	"	3.01	"	"

Under the heading of "Surface and Inspection," "and must be of uniform thickness throughout, except at the weld, where one gage number additional thickness will be allowed" be changed to read "where .015 inches additional thickness will be allowed."

The committee urges strongly the importance of using the decimal gage in ordering all kinds of material for which it was designed and adopted by the association.

Driving Box Wedges.

J. DAVIS BARNETT, H. A. CHILDS, T. J. HATSWELL, R. ATKINSON, R. E. READING, Committee.

The replies to the circular of inquiry issued by this committee only numbered 49, but of those answering, a decided majority are in favor of wedges that cannot be adjusted on the road. The data presented to the committee by members was unsatisfactory and the committee says that the strongest point the replies justify them in making is that those who dispense with movable wedges do not go back to them.

MASTER CAR BUILDERS' ASSOCIATION.

ABSTRACTS AND SUMMARIES OF REPORTS PRESENTED AT THE THIRTIETH ANNUAL CONVENTION.

Axle, Journal Box, Bearing and Wedge for Cars of 80,000 Pounds Capacity.

E. D. NELSON, J. H. RANKIN, GEORGE GIBBS, WILLIAM FORSYTH, JOHN HODGE, J. E. SIMONS, F. W. CHAFFEE, Committee.

The larger part of the report has been devoted necessarily to the axle, not only because it was essential first to decide upon its design before the journal box, wedge and brass could be considered, but because it was realized that there were two limits between which it was necessary that the design should fall. The first of these was that the limit for strength should, unquestionably, leave no doubt as to the *safety* of the design. The breaking of a car axle is becoming daily a more serious matter. On double track roads it involves not only the safety of the train in which it may fail, but of both passenger and freight trains on the opposite track. Evidence of the seriousness of this matter is only too easily obtained. The other limit was that of cost. To meet these ends has been the aim of your committee.

The plan of the report is to discuss first theoretically the matter of strains in the axle, in which is included from practical information the important element of vertical oscillation on the springs. The question of fiber stress is then considered, and following this is a discussion of the journal proportions from the standpoint of friction and lubrication. Conclusions having been reached under these heads the design of the axle naturally follows, with specifications for the material to be used. Reference to the designs for journal box, wedge and bearing will be found in the concluding paragraphs.

Next follows a complete analysis and calculation of the strains in an axle resulting from all the forces acting on it, Reuleaux's method being employed. These calculations are compared with a second set computed by the method of Wohler, which is based largely on experimental data obtained with four-wheeled cars on Prussian railways. We have not the space to devote to these excellent mathematical demonstrations, but must refer our readers to the report itself. One interesting experiment in this connection, however, we record. To apply the calculations to practice, it was necessary to know how much the static load on the axle was increased by the vertical oscillations of the car on its springs. Wohler states, from his experiments with four-wheel cars on the Prussian State railways, that the weight on the journal is increased three-eighths by the force due to vertical oscillation. As this was determined by experiments in four-wheel cars and on railroads in Prussia the committee endeavored to confirm this figure by experiments on American railways and with eight-wheel cars.

The method employed was as follows: A car fitted with Fox trucks was selected, the box springs taken out, and each spring was carefully calibrated, to show the force necessary to compress it each one-eighth of an inch from the height of spring free to the spring when down solid. Each spring was then fitted with a simple recording apparatus, shown in Fig. 1, intended to register the maximum compression of the spring in inches, and the springs were replaced in the trucks.

A piece of ¾-inch gas pipe *C* was finished outside and slotted longitudinally at *B* and fitted in the hole *A* drilled through center of spring cap, and having sufficient friction so as not to be moved by any jolting of the truck.

Any compression of the spring caused the pipe *C* in contact with the boss *D* on the journal box to be forced upward into the hole *A*, where it would remain, thus registering the compression of the spring.

The car was a box car of 60,000 pounds capacity and was loaded to 67,800 pounds; the light weight was 34,400 pounds; the total being 102,200 pounds; the total weight of wheels, axles, boxes, brasses, etc., was 7,848 pounds; this deducted from 102,200 pounds leaves 94,352 pounds as the weight above the springs, which divided by 4 gives 23,588 pounds as the weight on each axle above the springs, or 11,794 pounds on each spring, due to the static load.

The car was then run from Renovo, Pennsylvania, to Canandaigua, New York, over the lines of the Pennsylvania Railroad, and back to the starting point, a distance of 398 miles. The springs were then removed and again calibrated, in order to check the former figures found, made before the car was started. The springs were also measured at the Altoona physical testing laboratory, to confirm the measurements made with the shop apparatus employed. The maximum compression of each spring was found from the recording apparatus, which was placed over each box.

The average maximum compression of the eight springs was found to be equal to a load of 19,469 pounds on each spring. The maximum compression for any one spring was found to be 23,403 pounds. From these figures it is proposed to deduce the value of the force due to vertical oscillation of the car on the springs.

If the maximum horizontal force acting on the car be taken as 40 per cent. of the static load and the center of gravity of the loaded car be 72 inches above the rail, calculation shows that in the case of the car tested the maximum load on one journal was 18,573 pounds, without considering the effect of vertical oscillation on the springs.

It can be proved that if the center of gravity of the car is 72 inches above the rail, that 40 per cent. of the static load acting horizontally will almost entirely relieve the weight on one rail. In other words, the assumed value of the horizontal force is very nearly sufficient to turn the car over. Hence we may consider the

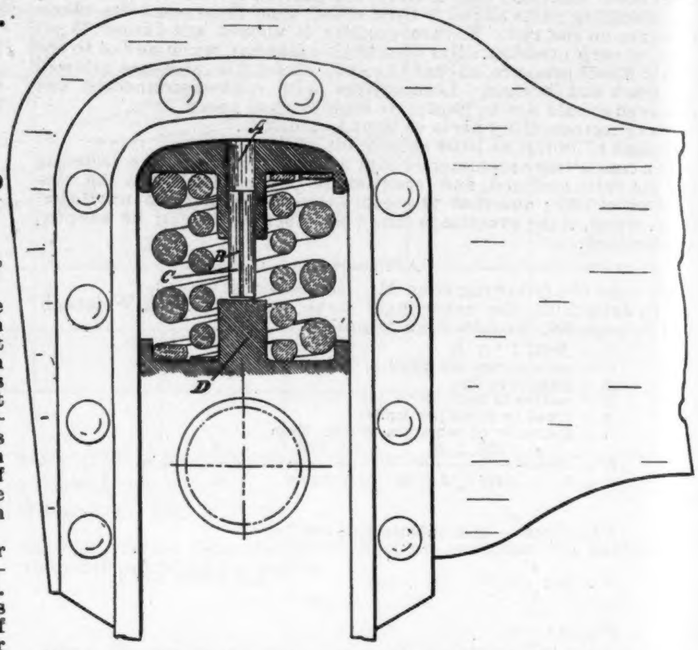


Fig. 1.– Apparatus for Determining Vertical Oscillation of a Car on Its Springs.

assumed value as a maximum, and with this assumption our calculation gives 18,573 pounds as the maximum compression on one spring due to that force and the static load. But the maximum compression on one spring by experiment was 23,403 pounds, and consequently the difference between these two amounts may be regarded as due to vertical oscillation of the car on the springs. This is not necessarily the actual vertical oscillation, but it may be considered as the maximum vertical oscillation when the horizontal force is taken as a maximum. This difference is 4,830 pounds. This is equal to 41 per cent., nearly, of the static load on each journal, which was 11,794 pounds. As formerly stated, Wohler found by experiment that the force due to vertical oscillation was ⅜ or 37.5 per cent. of the static load on each journal, so that the amount as found in the experiment made by the committee agrees closely with his results.

The formula for the moment of the forces at the hub and at the center when the axle is mounted on 33-inch wheels is by Reuleaux's method found to be as follows:

$$M = \frac{W b}{2} - \frac{H h}{m}(x - b) + \frac{H h_1 x}{l} + H h_2 + \left(\frac{W}{2} - \frac{H h}{m}\right) h_2 \tan a \qquad (1)$$

where

W = the total vertical pressure on the axle, including allowance for vertical oscillation.
H = horizontal force caused by curves, switches and wind pressure.
h = height of center of gravity of car above top of rails.
h_1 = height of center of gravity of car above center of axle.
h_2 = height of center of axle above top of rails.
l = length of axle between points of application of total load W.
m = distance between center of rails.
b = the distance from center of rail to point where load on journal is assumed to act.
x = any distance along axle from point where load on journal is assumed to act.
a = angle between head of wheel and the horizontal.

According to Wohler's method the formulas are as follows:

For the hub

$$M = .176\, W b + .516\, W + 322.245 \sqrt[4]{W} + 4.125\, H$$

and for the center

$$M = .176\, W b + .516\, W + \tfrac{1}{2}(322.245 \sqrt[4]{W} + 4.125\, H)$$

where M = the moment of the forces,
W = the total weight above the springs,
H = the horizontal forces.
b = distance from center of rail to point where journal load is concentrated.

The diameters at the hub and at the center may be calculated by the well-known formula

$$d = \sqrt[3]{\frac{M}{.0982f}}$$

where M = the moment of the force,
f = the fiber stress.
d = the diameter of the axle.

These formulas suffice to determine the dimensions between the wheels when the maximum allowable fiber stresses are decided upon.

The committee have in these general formulas taken into consideration all the forces acting upon that portion of the axle lying between the wheels, except the force due to impact or percussion. This latter is confined entirely to the journal and that portion of the axle lying outside of the wheel, and is not communicated to that part of the axle lying between the wheels, because in order to have any force applied at the journal produce a bending of that portion of the axle lying between the wheels it is necessary that the part of the wheels in contact with the rails should move toward each other, and that the tops of the wheels should at the same time move away from each other. The resistance to this movement

would be the inertia of the mass of the wheels themselves, and also the friction of the wheels when sliding inwardly on the rails if such movement took place. The force of impact would not take place over a sufficiently long interval to allow any effect upon the axle between the wheels. Wohler states that the portion of the axle lying outside of the wheels can only be determined from practical considerations.

We have determined how the diameter at the center of the axle and at the hub may be found. Now if we consider the weight acting at a point in the journal, the form of the axle from that point to the wheel fit, in order to have it of uniform strength, would be a parabola. This is within the demensions necessitated by running the wheel fit out cylindrically and providing proper diameters for the dust-guard seat and journal. Hence the margin of strength in the journal and dust-guard seat is much above that taken for the hub and center.

FIBER STRESS.

Under this head the committee first takes up the natural limits of elasticity. When testing was first employed to determine the nature of a material, it was quickly noticed that when the specimen was loaded or bent beyond a certain point it would not recover its original dimensions or shape upon the removal of the load. The limiting stress or straining, below which no permanent effect upon the specimen could be noticed, was called the "elastic limit." It appeared obvious to experimenters that since the specimen recovered completely its original form and dimensions, it had not been injured, and it would be safe to apply any loads within the elastic limit indefinitely without any injury resulting.

Subsequent practical experience, however, proved that under the conditions of repeated reversals of stress it is not safe to subject a bar to a strain anywhere near the elastic limit, *as determined in the testing machine.*

According to Wohler, who spent some 12 years at the instance of the Prussian Government in experimenting upon the effect of repeated stresses in small bars, the outer fiber stresses, where the strains alternated between tension and compression, he found might be safely taken as 17,000 pounds per square inch for iron and 23,000 pounds per square inch for steel, without limiting the life of the bar, but if the stresses exceed these limits, fracture would always occur if the number of repetitions of stress were sufficient. This is a stress of approximately ⅜ the tensile strength of the material, and is considerably within the elastic limit as ordinarily determined.

In large bars, such as car axles, where the extreme or outer fibers are a considerable distance from the neutral axis, and where the material is often far from homogeneous throughout, it is reasonable to suppose that strains are not transmitted symmetrically in all its parts and some of the fibers may bear a larger proportion of the total stress than would occur in even distribution. In this way the elastic limit may be locally exceeded with a very moderate total stress only.

From all evidence it seems reasonable to conclude that a material will not be injured if strained repeatedly any amount within its natural elastic limit; that the so-called "fatigue of metals" may be noticed if strains are in excess of this natural elastic limit, and still within the elastic limit as ordinarily determined; that there is a possibility of the natural elastic limit being exceeded at points locally within the structure of a large mass by a moderate total strain, thus starting local cracks which will extend to the ultimate destruction of the piece.

As to the effect of temperature, it seems to be pretty well established that the effect of ordinary atmospheric changes of temperature, say, from 20 degrees below to 120 degrees above zero Fahrenheit, upon the physical properties of iron and steel, are slight and unimportant when stresses are applied without shock. But the effect of a change of temperature upon the ability of these metals to resist shocks is not so definitely known.

Mr. Thomas Andrews, in a paper read before the Institution of Civil Engineers, 1887, gave results of tests by impact under a drop hammer, of forty-two full-size iron axles, the axles having been heated and cooled to various degrees, for the purpose of determining the effect of temperature upon strength.

He found that at 100 Fahrenheit the axles were 43 per cent. stronger than at 7 degrees, and concludes that low temperature materially reduces the power of resistance of railway axles to continued heavy impact.

It is to be doubted, however, whether these tests throw much light upon the effect of temperature upon axles as stressed in service, since the shocks in his method of tests were altogether more severe than those met with in service, from six to eight blows being sufficient in each case to break the axle. In fact, experience in this country shows that few, if any, more axles are broken in cold weather than in warm, and it is reasonable to assume that the greater rigidity of the road-bed in winter would fully account for any greater percentage of breakage in that season than in summer. Carefully kept records of axles broken or bent on one of the largest railway systems in this country show that no larger number of axles failed in the colder months than in the warmer ones.

Your committee would consequently offer the opinion that temperature need not be taken into account in determining the design of axle; but that with more definite information it may be advisable that certain limit for variation of temperature should be established as standards for use in testing axles under the drop.

It has been stated that Wöhler found that for an unlimited number of reversals of strain, the fiber stress may safely be taken at 17,000 pounds per square inch for iron and 23,000 pounds per square inch for steel. But as his experiments were made with small specimens, and as axles are subject to various stresses, apparently not included in his investigations, it would seem best to look into the fiber stress of axles in service and see what can be learned. The method of Reuleaux, already given, can readily be utilized to determine the fiber stress of any given axle. It is only necessary to find the moments and from the actual diameters find the fiber stress.

Your committee has followed this method for axles already in use, where they have been in service a number of years, and where the number of axles has been sufficient to justify safe conclusions by such an analysis.

Taking the fiber stress calculated in this way it was found that a large number of axles had broken of one design where the fiber stress was 28,000 pounds, these axles having been in service from four to nine years. Where the fiber stress was 23,000 pounds and less, the records show that axles have been practically free from failure by breaking.

The fiber stress of 28,000 pounds was found approximately the same at the wheel seat and center, and the records showed that breakage took place at both of these points.

Furthermore, the axles with the lower fiber stresses, and which have not broken, show that for the strains found by Reuleaux's method the fiber stress is approximately uniform between the wheels.

Your committee has concluded, therefore, that if the new axle is designed, using the strains as found by Reuleaux's method, and if a fiber stress of 22,000 pounds per square inch is taken for the portion of the axle between the wheels, and the material provided in the specifications is used, a safe design will be the result without much surplus material.

Concerning the fiber stress in journals, this portion of the axle is subjected to strains of a more complicated nature, and the results of experience will be the safest guide.

From an examination of the fiber stress in journals which have broken and which have not broken, it is concluded that, for the diameter attained when the journal is worn to its limit, the fiber stress for static load should not exceed 11,500 pounds per square inch. It would be safer to keep it close to 10,000 pounds per square inch, which figure has been adopted for the diameter when it has reached the limit of wear.

From the diagram, Fig. 2, the fiber stress in a 5 by 9-inch and 4¼ by 8-inch journal when new, worn, and worn to limit, can be found for any load from 9 000 pounds to 35,000 pounds. The load W is applied at a distance J from the shoulder of dust-guard seat. The value of J is 5⅝ inches for a 5 by 9-inch journal, and 5⅛ inches for a 4¼ by 8-inch journal. The lever arm T for moments is shown in each on the diagram and is taken from tangent of circle at fillet to point of concentration of load W.

It will be seen that the stress under a static load of 15,500 pounds, is, for a new axle with a 5 by 9-inch journal, 6,300 pounds, and when worn to limit, 4½ inches in diameter, it is 10,200 pounds. A new axle with 4¼ by 8-inch journal, with a static load of 11,000 pounds,

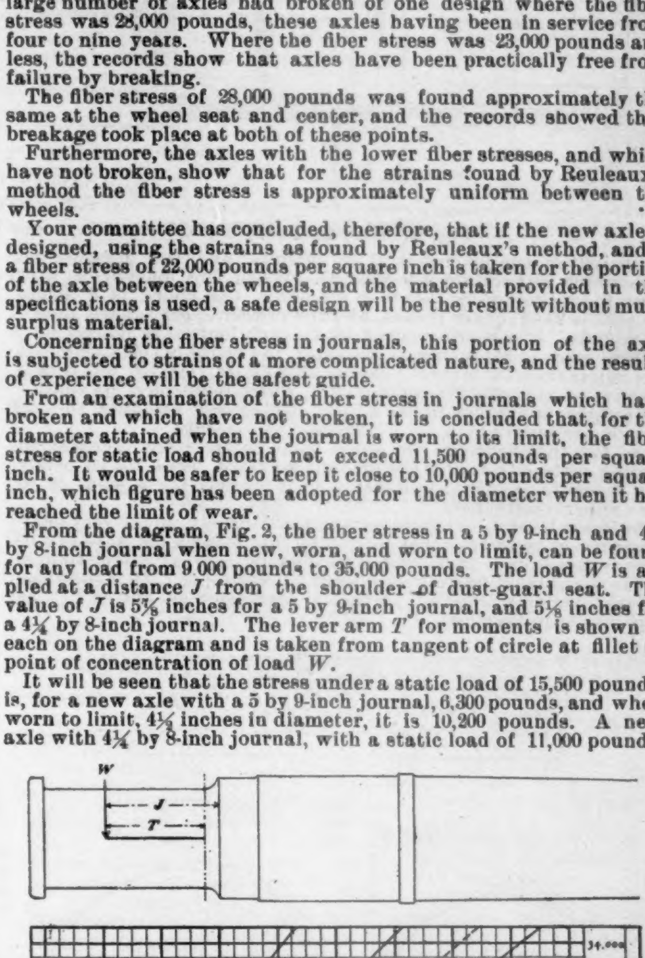


Fig. 2.—Fibre Stresses in 5″ × 9″ and 4¼″ × 8″ Journals.

would have a fiber stress of 6,500 pounds when new and 10,800 pounds when worn to the limit of 3¾ inches in diameter.

The stress in the journal due to any assumed maximum load may thus be found direct from the diagram.

THE JOURNAL—FRICTION AND LUBRICATION.

Considering the proportions of the journal with respect to friction and lubrication, the principal figure desired is the maximum pressure per square inch which can be placed on freight car journals without undue friction, wear of bearing and liability to heat.

Laboratory experiments made in this country and Europe do not give any satisfactory data on this subject, and we are compelled to assume that the 4¼ by 8-inch journal is satisfactory for cars of 60,000 pounds capacity, and determine from this the pressure per square inch to be allowed on the new journal. Fig. 3 is a diagram showing the method of determining the area of bearings.

The chord of a new bearing 4¼ inches in diameter is 3.56 inches, and, leaving out fillets, the length is 6⅞ inches, and its area 24.48 square inches. Under a loaded car, allowing 10 per cent. overload,

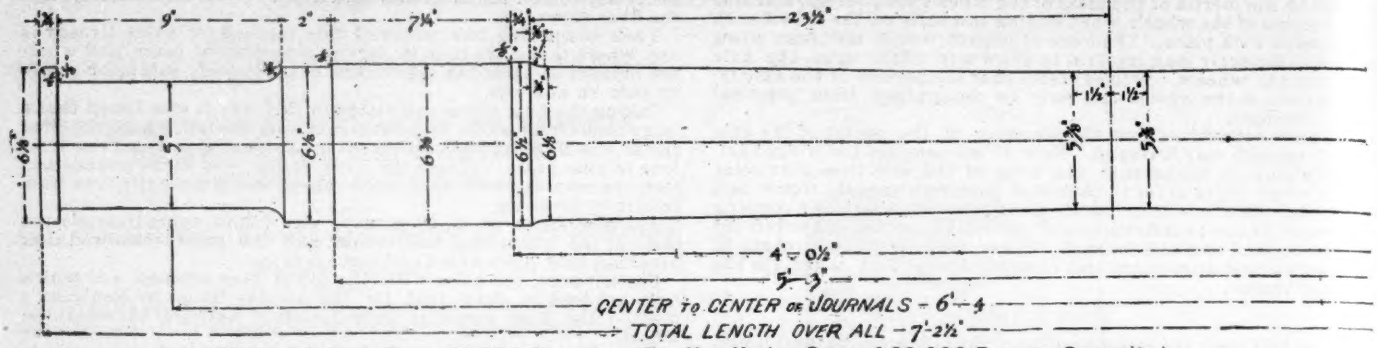


Fig. 4.—Axle to Carry 31,000 Pounds. (For Use Under Cars of 80,000 Pounds Capacity.)

the weight on one journal is 11,000 pounds, and the pressure per square inch is therefore 449 pounds. When the journal is worn down to its limit of 3¾ inches in diameter, the chord is 3 inches, the area is 20.63 square inches, and the pressure per square inch is 533 pounds. If a bearing bored for 4¼-inch journal is placed on a journal worn to 3¾ inches in diameter, the chord of the arcs in contact is less than 1¼ inches. Taking this figure, 1¼ by 6⅞ inches, we have an area of 8.59 square inches, which must carry its share of the weight, and which under a fully loaded car amounts to 1,280 pounds per square inch.

The fact that bearings run some time before they increase the bearing surface to double the amount assumed leads us to believe that it would be safe to proportion a car journal for a load of 600 pounds per square inch.

Professor Denton's experiments on car journals, under very heavy pressures, showed that they might be run under a pressure of 5,000 pounds per square inch, and that the rapid wear would soon increase the area of bearing, and with a pressure of 1,000 pounds per square inch on a polished journal a coefficient as low as 0.11 per cent. has been obtained.

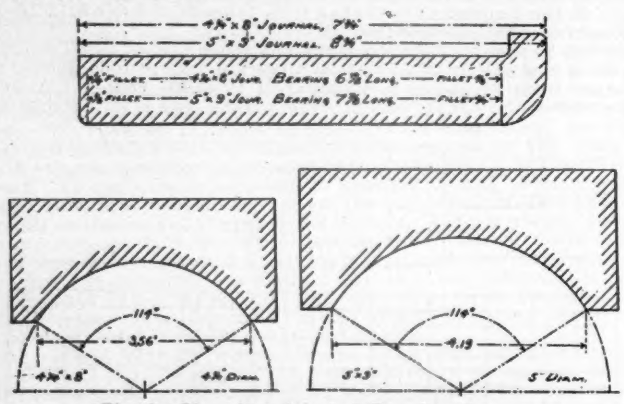


Fig. 3.—Showing Journal Bearing Areas.

For the axle designed to carry 31,000-pound stresses under the maximum load, as has already been seen, would require the journal to be at least 4⅜ inches in diameter; adding ⅝ inch for wear it would be 5 inches in diameter; and if we make its length 9 inches and the bearing ¼ inch less, by leaving out fillets we get the length of effective bearing as 7⅞ inches. Taking the same angle of contact as the 4¼ by 8-inch bearing, the length of chord would be 4.19 inches, and the bearing surface of a new journal would be 33 square inches. Taking 15,500 pounds as the load on journal, we have a pressure of 469 pounds per square inch. When worn to 4⅜ inches diameter the chord would be 3.75 inches and the area consequently 29.53 square inches. This gives 525 pounds as the pressure per square inch.

In our final calculations we have assumed the probable maximum conditions for concentration of the load on journal, which would be when the collar of the journal is worn to ¼ inch in thickness from contact with the brass and the brass worn off ¾ inch on the end next to the collar of the journal. This occurs when the horizontal force previously explained is at its maximum.

DESIGN OF AXLE—REULEAUX'S METHOD.

Having prepared the general methods to be followed and determined the necessary data, we may take up at once the design of the axle. The committee was instructed to design an axle for an 80,000-pound-capacity car, but concluded that the capacity of the car is not a proper measure of the weight carried by the axle.

We will therefore determine for an 80,000-pound-capacity car what would be the maximum weight on each axle, and it should then be understood that the design of axle submitted in this report is one designed to carry that weight, and not an axle for an 80,000-pound-capacity car, regardless of the weight of the car body and trucks. We may assume for the probable weights of 80,000-pound-capacity cars the following:

Gondola car.

Weight of body and trucks	35,600 pounds.
Lading	80,000 "
Twenty per cent. additional lading	16,000 "
	131,600 pounds.
Deduct weight of wheels and axles	7,600 "
	124,000 pounds.

or 31,000 pounds per axle.

Refrigerator car.

Weight of body and trucks	43,600 "
Lading	80,000 "
Ten per cent. additional lading	8,000 "
	131,600 pounds.
Deduct weight of wheels and axles	7,600 "
	124,000 pounds.

or 31,000 pounds per axle.

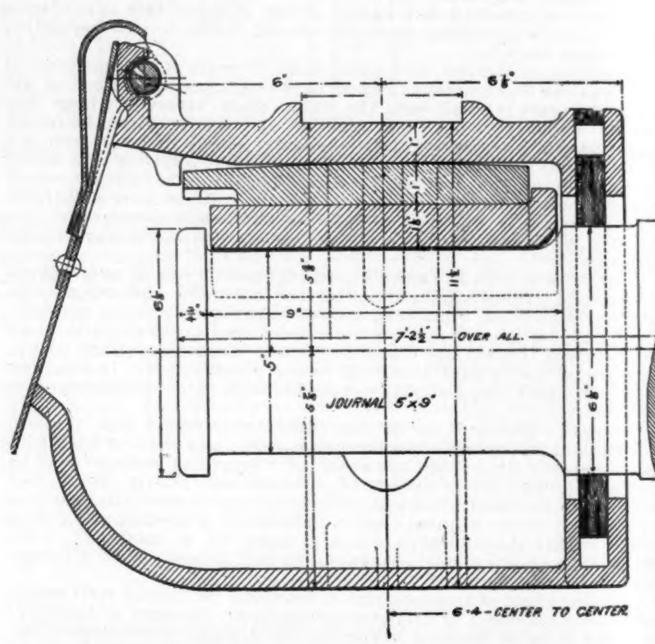


Fig. 5.—Journal Box Complete for 80,000 Lbs. Cars.

NOTE—Distance between bolt centres equals 9 inches.

The axle recommended by your committee is therefore designed to carry 31,000 pounds, including body, trucks and lading. It should be distinctly understood that the axle recommended is to carry this weight, as the sum of the weights of the car body and trucks and lading when using 33-inch wheels.

On the basis of 31,000 pounds static load on the axle and a maximum fibre stress of 22,000 pounds the required diameter of the axle at the hub is found by Reuleaux's method to be 6.21 inches and at the center 5.30 inches; or taking the nearest ⅛ inch for convenience, 6¼ and 5⅜ inches, respectively. To the diameter at the hub it is necessary to add ⅛ inch to provide for reduction of diameter when fitting axles to wheels as allowed in the interchange rules; hence the diameter at the hub becomes 6⅜ inches. Wohler's method would give a less diameter at the hub and greater at the center, but the results of Reuleaux's methods are taken as the better.

DESIGNS FOR AXLE, JOURNAL BOX, WEDGE AND BEARING.

In Fig. 4 is given the design of axle to carry 31,000 lbs.

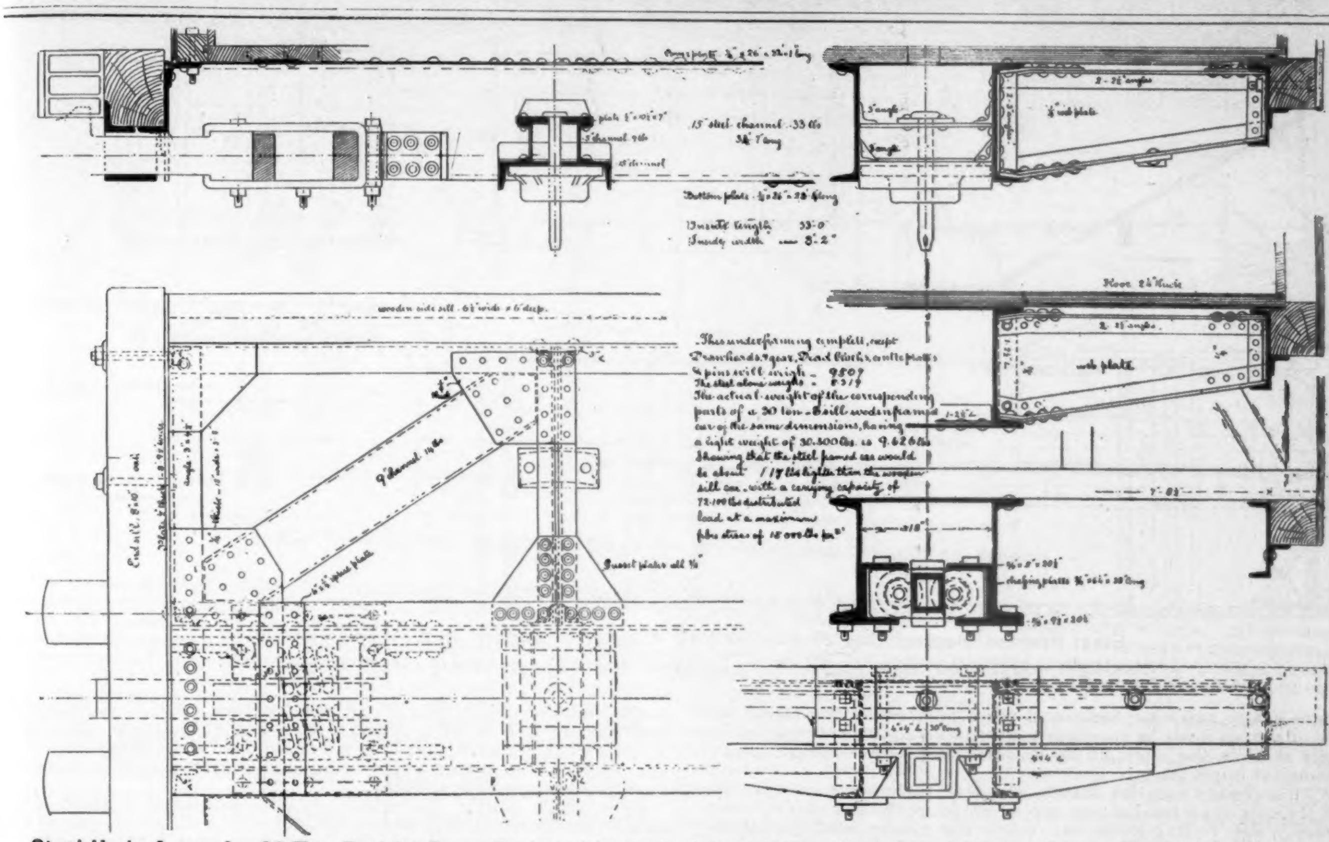
It will be noticed that the axle is cylindrical for a distance of 3 inches at the center, in order to get rid of the angle at the center. The fillet at outer end of journal is made as small as possible without getting a sharp corner, and still making it easy to obtain in ordinary shop practice. The fillet at back end of journal is made large to prevent the rapid wearing to a small fillet at this point.

Fig. 5 shows the journal box and the contained parts in position.

The general design of the M. C. B. journal boxes, already adopted by your Association, has been followed, except that the bottom of the box has been rounded in order to eliminate the corners and to concentrate the oil below the center line of journal, where it has the greatest opportunity to be drawn into the packing.

[Separate drawings of the box, wedge, bearing and lid are shown, but are not reproduced.—ED.]

In another drawing (not reproduced here) is given a portion of the same journal box, except that the face of box has been changed to suit the Fletcher lid. This form of lid has so many advantages that your committee decided to ask consideration of



Steel Underframe for 30-Ton Freight Cars—Designed by R P. C. Sanderson, Asst. Supt. Motive Power, Norfolk & Western Road, and C. C. Wentworth, Chief Engineer, Virginia Bridge Works.

it as compared with the form of lid already adopted for cars of less capacity.

SPECIFICATIONS.

A set of specifications for iron and another for steel axles accompany the report. They go into minute details and would occupy too much space to be printed here. A summary of the steel-axle specification is as follows: The axle must be free from physical defects that can be detected by the eye. It must be rough-turned all over with a flat-nosed tool, except for a short distance just inside of each wheel fit. The composition of the steel must conform to the following:

Carbon	0.40 per cent.
Manganese, not above	0.50 " "
Silicon	0.05 " "
Phosphorus, not above	0.05 " "
Sulphur, not above	0.04 " "

All axles must be stamped with name of maker and the blow or heat number. Axles from any one heat must be kept together for inspection. At least 30 axles from each heat must pass the physical inspection. Then one axle from each heat passing this inspection will be subjected to physical (drop) test. The drop test must be carried out on a machine with a spring-supported anvil similar to that illustrated in the *American Engineer* for April, 1896. The anvil is to weigh 17,500 pounds; the drop weight, 1,640 pounds. Each axle must stand five blows from a height of 43 feet, without rupture or fracture. A deflection is desired of not more than 5½ inches, after the first blow, and a deflection of more than 6½ inches will cause rejection. Axles will be rejected if the chemical test shows:

Carbon	below 0.35 per cent. or above 0.50 per cent.
Manganese	" 0.60 " "
Phosphorus	" 0.07 " "

The specifications for iron axles call for double-worked fagoted scrap, into the center of which 80 pounds of new bar iron can be worked if desired. They must not show any seams having a clear opening of $\frac{1}{32}$ inch or more, and being more than 1 inch long. From each 101 axles, one will be taken for test. The drop test which it must pass is the same as for steel, except the five blows are from a height of 23½ feet.

Metal Underframing for Freight Cars.

R. P. C. Sanderson, J. D. McIlwain, J. R. Skinner, John Player, Committee.

With the gradual and steady increase in the carrying capacity of freight cars and in the hauling power of freight locomotives, the insufficiency of the earlier methods of freight-car construction, developed from wagon building, consisting of timber framing held together by nails, spikes, straps, lag-screws and bolts, became more apparent.

The lessons learned on the repair tracks led to the strengthening of freight-car body bolsters and longitudinal sills with truss roads, and, finding this to be still insufficient, the timbers have been reinforced with iron and steel as in the well-known flitch-plate bolster, or in the fairly effective plating of bolsters, end and longitudinal sills.

Some designers, recognizing the inherent weakness in any composite form of construction where wood is used, went at once to iron for body bolsters, of which there are numerous designs of the built-up type. Here should also be mentioned the Schoen pressed steel, American and Shickle, Harrison & Howard cast-steel body bolsters, which have been extensively illustrated in the technical journals and are well known to the members.

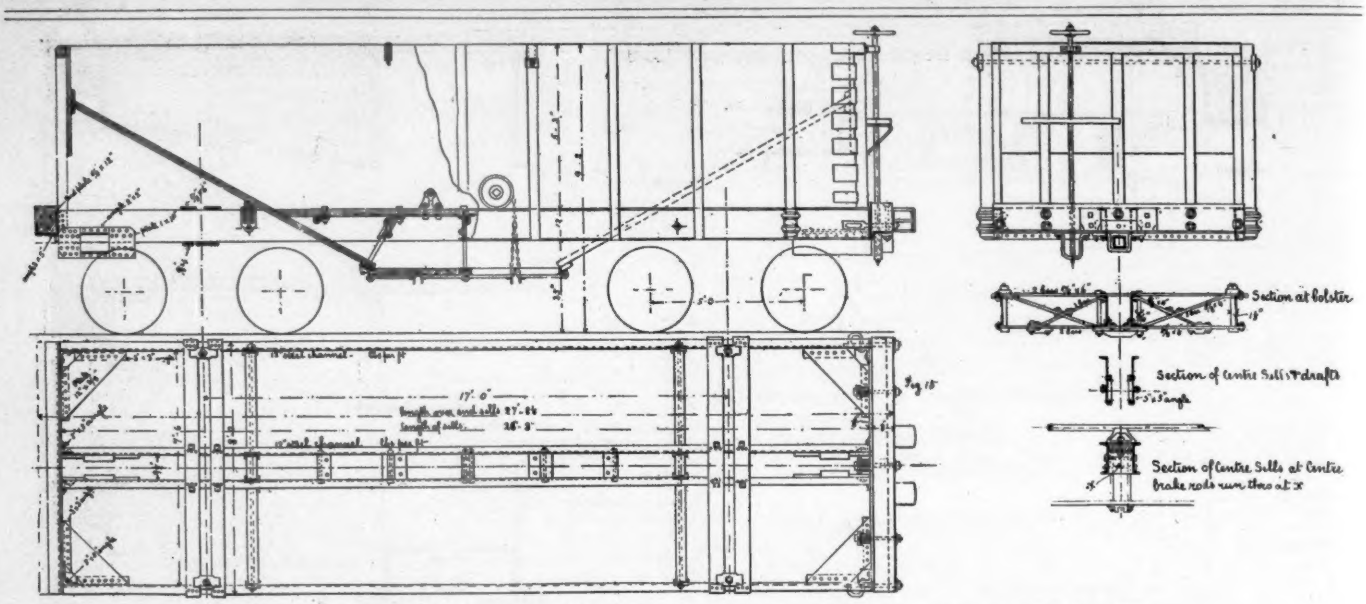
The Chicago, Burlington & Quincy Railroad car (See American Engineer for March, 1896) marks a long step ahead in that the center sills, as well as the bolsters, are of steel. It is very probable that the use of iron and steel in car construction would have advanced far beyond its present standpoint but for prejudice which has grown up in the minds of many against any and all iron or steel cars, as the result of some unfortunate ventures in which the designers either did not fully understand the service and strains a freight car has to withstand, or from lack of experience, and in an endeavor to keep the weight and cost of their cars down to limits which would enable them to make sales, placed cars in service that have become a by-word on account of their frequent and prolonged sojourns on the repair tracks.

It would be quite as unjust to condemn all iron or steel car construction on account of these failures as it would be to condemn the use of wood in car construction because some of the earlier builds of cars, and even some comparatively recent designs, are so poorly proportioned that they are constantly failing. The obviously proper course is to profit by these early failures in iron car construction, make use of the experience gained and go on with the development of the steel car frame, trying to avoid the errors of the past. It is only necessary to remind those present of some of the exhibits at the Chicago Exposition to show that progress has been made in the right direction.

Even if the members of your committee felt that they could present a design for standard steel framing for freight cars which would be practically perfect and require no future modification (which is not the case), it would not be practicable to do so until greater uniformity in the lengths and sizes of interchange freight cars for given capacities has been brought about. It is to be hoped that a thorough inquiry into the subject will be made by the Association by means of a committee to recommend standard lengths of sills and widths over sills for refrigerator, box, stock, flat, drop-bottom and drop-end gondola cars of 60,000, 70,000 and 80,000 pounds capacity, and that the Association will adopt such standards.

After this step has been taken, then, with sufficient experience and knowledge to guide them, a committee could take up the subject of steel underframing for freight cars, and, with good hope of success, present to the Association a series of designs for M. C. B. steel underframes that could be adopted and used, as far as their general features are concerned, without fear of serious failure ensuing.

As long as the main framing of foreign freight cars coming on our repair tracks is of timber (which can be cut and dressed to suit by the ordinary carpenters' tools), and of iron truss-rods and bolts (which can be cut or welded by any blacksmith), odd sizes of sills, etc., are not such a serious matter, but when we come to steel and iron, which



Steel Framed Hopper Car of 60,000 Lbs. Capacity—Norfolk & Western Railroad.

Total light weight of car 29,800 lbs., or 1,500 lbs. more than weight of same class of cars with wooden sills.

require heavy machine tools and shop treatment, and where odd sizes or shapes must be specially ordered and rolled or forged at the forges or mills, the question of uniformity of sizes becomes one of paramount importance.

With standard lengths, depth, width of flange and weight per foot for sills of all flat-bottom cars of 60,000, 70,000 and 80,000 pounds capacity, the rolling mills can carry the stock ready for instant shipment, feeling safe that they will not have it left on their hands as obsolete stock; the sills and shapes in stock at any railroad shop store would be certain to suit any foreign car that might come on the repair tracks, only requiring that the holes, etc., should be laid off and punched or drilled to suit the details of the particular car, but before this happy state of things can be brought about, the standards for lengths and widths of cars must be adopted, and—when steel-framed cars are built—rigidly adhered to.

Pending the adoption by the Association of the standard lengths and widths for given capacities, your committee present the following rules or recommendations, which they feel justified in asserting should be seriously considered by designers of steel framing for freight cars.

First. Especially forged, pressed or rolled shapes, cast steel, etc., or patented forms of construction are undesirable for cars to be used in general interchange business, no matter how well designed theoretically, for the reason that when such parts are damaged there must necessarily be long delays in ordering and obtaining these special parts, and should the parties who have furnished them go out of business, or change their molds or patterns, the parts cannot be duplicated for repairs except at enormous expense and loss of time.

Second. Steel and iron bars and shapes of standard bridge specifications and regular market sizes should be generally preferred, so that railroads and car builders can avail themselves of the competition in the open market when purchasing, or if not equipped to put steel frames together themselves, can have this work done for them at any of the numerous bridge-building concerns on competitive bids. The underframes, riveted or bolted together, can be shipped by carload lots to the car shops to be completed into finished cars.

Third. Get-at-ableness in the design is of the greatest importance in keeping down the first cost and maintenance; parts that are to be riveted together should be so arranged that they will be equally convenient for hydraulic or power riveting when the car is being built, or for field riveting in repair work.

Fourth In designing riveted work, it should be laid off with plenty of rivets, these to be spaced close, as in boiler work, and the same care to insure true fair holes, hot rivets, well driven and completely filling the holes, as in first-class boiler work, is necessary. Complaints sometimes heard against riveted work in car frames and tender frames, on account of loose rivets, can be directly traced to an insufficient number of rivets and poor riveting.

Fifth. If bolts are used to hold iron or steel parts in position, not merely to carry weight, they must be turned bolts (a driving fit), in carefully reamed holes, fitted with the greatest care. When so fitted they will probably give no trouble from working loose, but as this is machine-shop work, such bolts should be avoided as far as possible, as it is not likely that such bolts will be fitted in this way on the repair tracks, while it is reasonable to expect that a hot rivet, well driven, can be put in anywhere with the aid of a portable forge. In both riveted and bolted work it is of the utmost importance to perfectly fill the holes, remembering that it is the "initial wiggle," if only 1-1000 part of an inch, that will surely produce loose rivets and bolts and oblong holes; no amount of hammering on the heads of rivetors tightening up nuts or bolts, or the use of lock-nuts, nutlocks or fibrous washers will be of any use if the holes are not perfectly filled.

Sixth. Every structure has a foundation, every machine has a bed-plate, every animal, bird, fish, and most of the higher works of nature, have a backbone or spine on or around which the structure is framed; this cardinal principle of design seems to have been largely overlooked in freight-car construction, and it is believed that the center sills of a freight car should be made its main strength and reliance, and that the entire load shall be carried from the platform, the upper works being simply arranged as a housing to confine and protect the load.

Seventh. To enable the center sills to withstand collision and severe shocks to the best advantage, these sills should be spaced so that they will be directly in line with the dead blocks, and thus take the buffing and collision shocks in direct compression. Also their depth should be such that at least the center line of draft and centers of the dead blocks will be within the vertical dimensions of the sills. When so arranged there will be no tendency from shocks or pulling strains to bend the center sills, either laterally or vertically, or to bend or break the end sills.

Eighth. That care should be taken to avoid punching or drilling holes in the flanges of channels or I-beams where these are subject to heavy strains, especially tension or bending strains, unless additional meterial is added to compensate for this.

Ninth. That with the change from wood to steel the necessity for truss rods no longer exists for cars of reasonable lengths, but that ample and sufficient strength can be obtained within reasonable limits of weight without the use of truss rods and consequent need of adjustment.

Tenth. On account of the sweating and rusting of iron and steel, wood is preferable to iron or steel for flooring, siding and lining of merchandise and stock cars. Much has been said and written on the subject of corrosion of iron and steel brake beams, bolts, pipes, rails, etc., from the action of sulphuric acid leachings from coal cars and salt-water drippings from refrigerator cars and manure drippings from stock cars.

There is no doubt that there is serious corrosion from these and other causes under certain conditions, but evidence exists that steel framing under tenders and iron work under coal cars in constant service, and steel framing of cars exposed to very damp and destructive climatic influences for many years, have not suffered materially from these causes. Doubtless preservative paints can be found that if properly used when the steel frames are first built and with occasional repaintings will sufficiently protect the steel from corrosion, but as this is a very important subject your committee would recommend that it be made a special subject for committee investigation by a series of tests ranging over nine or ten months' time.

There is an economical side to this question which your committee desire to call attention to before closing their report, namely, how much additional weight and how much additional first cost dare be put on a car without ultimate loss.

First. As regards the question of increased light weight of freight cars of given capacities having steel underframes, your committee feels that they need only state that it is proven to be quite practicable to build cars with steel frames of greater strength and capacity with less light weight than when wooden or composite underframing is used, and that with more experience in the right methods of construction and a proper appreciation of the capabilities and best uses of steel, the proportion of carrying capacity to light weight can be still further increased for large capacity cars without danger of increasing the subsequent running repair account.

Second. With regard to the question of probable increased first cost of freight cars having steel underframing, the burning question here is, "Will it pay?" There are so many factors governed by local conditions which must enter into the calculation that each company must perforce figure this out for its own set of conditions.

One factor, namely, the repair account should, however, here receive passing notice. From the best information obtainable your committee believes that it is very nearly correct in stating that the charge for wheels, axles, springs, paint, chain, brake shoes, brasses, couplers and other parts that will wear out and fail as much under the most perfect steel-framed car as under the poorest design of wooden-framed car in the same service will constitute about 50½

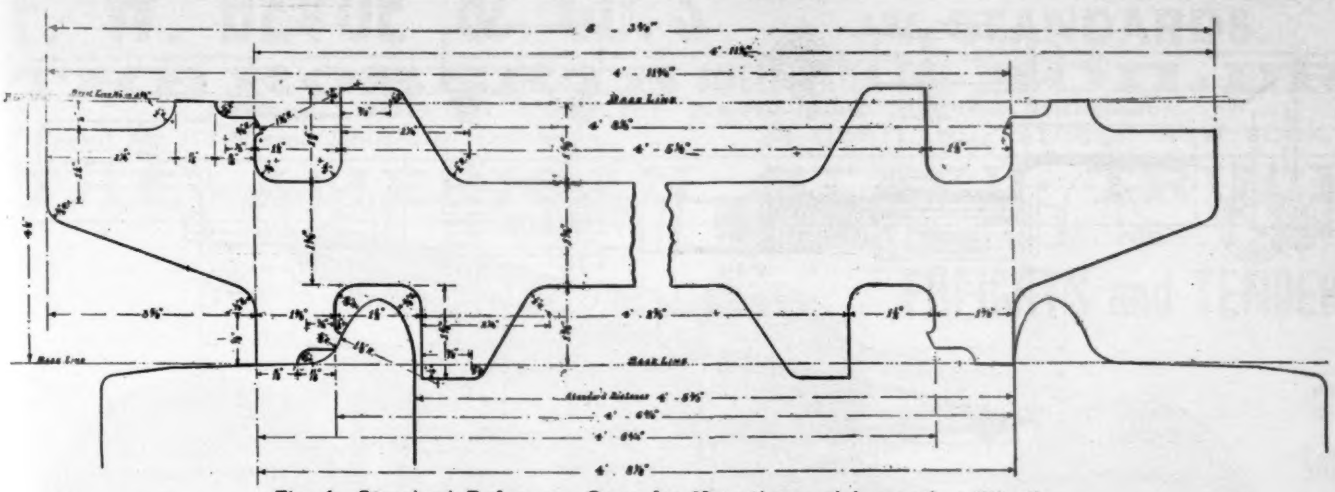


Fig. 1.—Standard Reference Gage for Mounting and Inspecting Wheels.

per cent. of the average total cost of freight-car repairs, exclusive of inspection, oiling and packing. Then the two question remain:

First. Of the remaining 49½ per cent. how much can probably be saved by the use of a perfect steel underframing which would require no repairs except painting during the life of the car?

Second. Will this saving, added to the increased freight earnings of the car and to the increased mileage earnings when away from home (due to a less number of days per annum spent on the repair track), pay the interest and depreciation on the extra first cost of the steel car?

Taking the figures given in "Poor's Manual," the freight earnings per revenue car for 1894 were about $1.38 per day, and the average mileage earnings of cars away from home are only about 15 cents per day.

Where the freight-car repair work is being kept up currently, the number of cars on the repair tracks can be kept down to 4 per cent. of the total equipment; this means that each freight car would spend about fourteen and one-half days on the repair tracks each year. If we assume that only 40 per cent. of this could be avoided by the use of perfect steel framing, we can possibly save about six days on the repair tracks per annum.

This would mean, if the freights were available, increased freight earnings of $8.28 per annum per car, or 90 cents additional mileage earned per annum per car away from home.

It is about right to assume, including private cars, that 30 per cent. of all freight cars are constantly away from home.

Taking one lot of 1,000 cars we can assume that as above the freight earnings could be increased........	$8,280.00	per annum
The mileage earned from foreign roads increased......	300.00	" "
	$8,580.00	" "
Estimated possible saving in repairs, say 20 per cent. of $72 per car per annum....................	14,400.00	" "
	$22,980.00	" "

As the steel framing when put up in lots by bridge builders ought not to increase the cost of cars more than $75 per car at most, this figure of $22,980 per thousand cars for savings and increased earnings would approximate 36 per cent. per annum on the extra capital invested, amply sufficient to cover the depreciation and interest charges under the conditions above assumed.

At the time of closing this report it is learned that the Illinois Steel Company is at work on designs for steel cars, drawings for which it is hoped will be received in time to present to the convention. It is also expected that a Norfolk & Southern steel flat, Norfolk & Western steel flat and steel framed hopper, Pennock steel car, Carnegie and Illinois Steel Company's cars will be completed and on exhibition at Saratoga for inspection by the members.

[The report is accompanied by drawings of the Norfolk & Southern steel flat car (illustrated by us in March, 1894), the steel bolster of the Northern Pacific (see our issue of March, 1896), the C. B. & Q. car with steel sills (in our issue of March, 1896), the Norfolk & Western steel flat and hopper cars of 20 tons capacity, a proposed design of steel frame for a 36-foot 30-ton car submitted by Messrs. Sanderson and Wentworth, the Pennock steel car, Trapp's 80,000-pound steel car, Player's steel frame and Carnegie Steel Company's hopper car of 100,000 pounds capacity. The latter cars weighs 39,000 pounds light. Some of these cars not already illustrated by us, and not found herewith, will be published later in a more complete manner than would be possible at present.—EDITOR.]

Mounting Wheels.

J. N. BARR, R. E. MARSHALL, J. C. BARBER, PULASKI LEEDS, J. H. McCONNELL, A. M. WAITT, THOS. SUTHERLAND.

The committee believes that the standard dimensions for wheel gages, as given in the Proceedings of 1895, are proper. In consideration of the check gage for mounting wheels, as shown in Plate 12, and the standard wheel gage, as shown in Plate 7 (M. C. B. Proceedings, 1895), it believes that these two gages should be combined, as shown in Fig. 1, and that the term "Standard Reference Gage for Mounting and Inspecting Wheels" should be applied to the combination.

It does not think that the gage in this form is suitable for practical work, either for mounting or inspecting wheels, but is more properly a reference gage; and it is for this reason it has suggested the name above. Attention is called to the fact that a slight change is made in the gage by enlarging the surface which comes in contact with the outside of flanges.

For the purpose of practical use in inspecting mounted wheels, both in shops and on the road, your committee presents a design, shown in Fig. 2, to be entitled "Standard Check Gauge." The only dimensions in this gage which differ from that shown in Fig. 1 is the distance between gage points, which is 4 feet 8¾ inches instead of 4 feet 8½ inches; but as this dimension is not used in inspecting, the discrepancy is immaterial.

The following instructions for using the proposed check gage explains all points in connection therewith:

INSTRUCTIONS FOR USING STANDARD CHECK GAGE.

In using the proposed check gage, if the projections *A* and *B* do not enter between the flanges, and the projections *C* and *D* rest upon the treads of wheels, the wheels should be rejected.

If the projection *A* is pressed against inside of the corresponding flange, the projection *C* resting on the tread, and the projection *F* does not allow the projection *D* to rest on its corresponding tread, the wheels should be rejected.

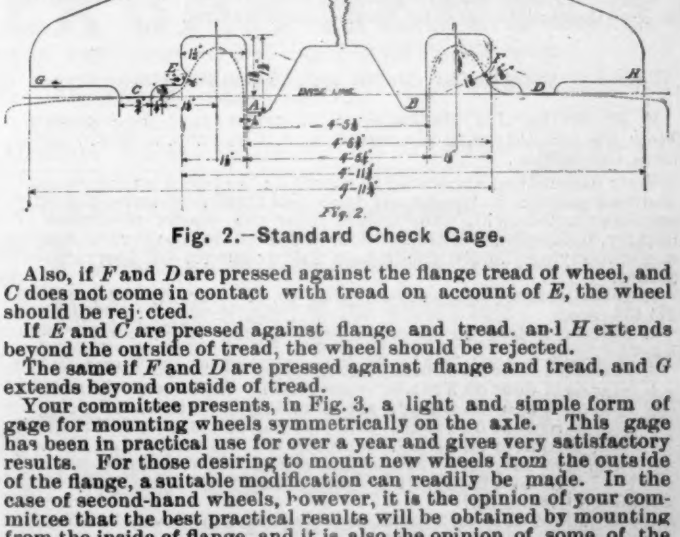


Fig. 2.—Standard Check Gage.

Also, if *F* and *D* are pressed against the flange tread of wheel, and *C* does not come in contact with tread on account of *E*, the wheel should be rejected.

If *E* and *C* are pressed against flange and tread, and *H* extends beyond the outside of tread, the wheel should be rejected.

The same if *F* and *D* are pressed against flange and tread, and *G* extends beyond outside of tread.

Your committee presents, in Fig. 3, a light and simple form of gage for mounting wheels symmetrically on the axle. This gage has been in practical use for over a year and gives very satisfactory results. For those desiring to mount new wheels from the outside of the flange, a suitable modification can readily be made. In the case of second-hand wheels, however, it is the opinion of your committee that the best practical results will be obtained by mounting from the inside of flange, and it is also the opinion of some of the members of your committee that the above remarks are equally true in the case of new wheels.

The committee believes that the best results will be obtained by the constant use of the proposed Standard Check Gage, at three or more points on the periphery of the wheels after mounting, as a positive guarantee of conformity to standards.

Your committee desires to urge upon all members of the Association the use of the standard maximum and minimum flange gages as a test requirement for all new wheels purchased before fitting them to axles.

In conclusion, it would summarize its recommendation as follows:

RECOMMENDATIONS.

First. That a standard reference gage for mounting wheels, covering the standard dimensions, shown in Fig. 1, be adopted, which shall combine the present check gage for mounting wheels, shown in Plate 12 of 1895 Proceedings, and the standard wheel gage, shown in Plate 7 of same year, the new combined gage to supersede the other two.

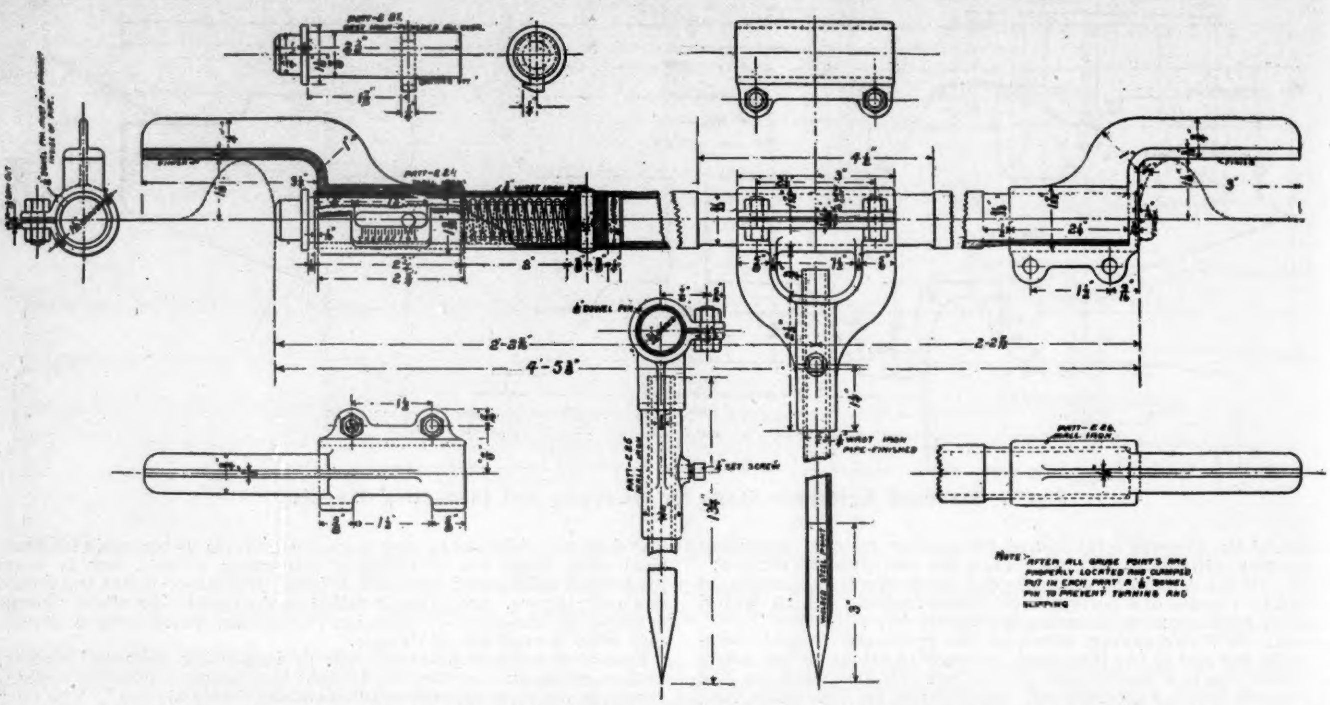


Fig. 3.—Gage Recommended for Use in Mounting Wheels Equi-Distant from Centers of Axles.

Second. That a standard check gage be adopted as shown in Fig. 2.

Third. That a gage for determining the center of the axle between centers of journals be used.

Fourth. That a gage for locating wheels equi-distant from the center of axles, as shown in Fig. 3, be adopted as recommended practice.

Fifth. That all axles be carefully centered between centers of journals prior to mounting.

Sixth. That wheels with flanges worn to a thickness of 1⅛ inches or less should not be remounted.

Seventh. That, as far as possible, the thickness of flanges of wheels fitted on the same axle should be equal, and should never vary more than ⅛ inch.

Eighth. That in mounting second-hand wheels, they be mounted to the standard distance between inside of flanges.

Freight-Car Doors and Attachments.

F. H. Soule, J. J. Casey, W. J. Robertson, B. E. Thomson, Thos. Fildes, Charles Waughop, A. J. Cromwell, Mord Roberts, Committee.

Your committee, appointed to report on the latest improvements and best practice in freight-car doors and attachments, respectfully submits the following data derived from the replies to circular of inquiry, indicating the kind of door standard to the several roads, and embodying therein the latest improvements in door attachments:

1. Total number of roads replying to circular 28, representing 274,434 cars.
2. Standard door on 13 roads, representing 123,810 cars, "Dunham."
3. Standard door on 3 roads, representing 40,614 cars, "Wagner."
4. Standard door on 3 roads, representing 7,851 cars, "Moore."
5. Standard door on 1 road, representing 17,469 cars, "Safety."
6. Standard door on 1 road, representing 22,438 cars, "Eubank."
7. Standard door on 1 road, representing 213 cars, "Lone Star"
8. Standard door on 1 road, representing 6,553 cars, "Kanaly."
9. Standard door on 2 roads, representing 27,352 cars, "Old style sliding on bottom rail."
10. Standard door on 3 roads, representing 33,134 cars, "Old style top hanger, sliding on flat iron."
11. Special safety brackets at bottom of door to prevent opening of door without breaking of seal are standard on six roads, representing 105,297 cars.
12. Special designs for door fastenings.
13. All but three of the twenty-eight roads employ the "batten" form of construction.

Your committee does not understand that its appointment contemplates a report on the merits of any particular device, or that the detail for recommended practice or standard door should be submitted. As covering, however, in a general way, the special features desirable in connection with an ideal freight-car door for box, stock and other classes of freight-car equipment, your committee would respectfully recommend that:

First. The door should be so constructed as not to be liable to bind or give trouble in working on account of swelling or warping slightly.

Second. The door should be hung at the top with no rail at the bottom which can be bent, and, from being bent, interfere with the free running of the door.

Third. The door should be hung so as to move readily by a small amount of force when applied either at the bottom, middle or at the top.

Fourth. The door should not move easily enough to roll back and forth by the alternate forward and backward jerks that the car gives in a freight train.

Fifth. The door should be so arranged as to be weather and cinder proof at the top, bottom and both sides when closed.

Sixth. The door should be so constructed that when it is locked and sealed, it would be impossible, without breaking and mutilating the door, to pry open the back end or bottom of the door, so as to permit entrance of the hand or hook to pull out portions of the lading.

Seventh. The door should be so constructed that if the lading presses against it and bulges it out from the inside when it is closed, it cannot be pressed away from the car so at to swing out and strike passing trains or other objects at the side of the tracks.

Eighth. The door should be so constructed as to make it absolutely proof against unhanging; excepting where the stop, against which it rests when open, is removed and the door taken off in the regular way.

Ninth. The door should be so constructed as to prevent it swinging out when in its closed position, even though all of the bottom brackets are removed.

Tenth. The door should be so constructed as to be proof against swinging out when in its closed position, in case one of the hangers should be broken or lost off.

Eleventh. The door should have such a style of locking arrangement that it cannot be removed or tampered with from the outside, without at once making the fact known to the seal record taker as soon as he sees the fastening.

The above conditions should be considered as applying to end doors as well as side doors, with special reference to locking arrangements, which should have the same or equal provisions for sealing. In this connection, and for such action as the Association may be pleased to take, a communication from Mr. John T. Denniston, President Freight Claim Association, is submitted, in which he asks whether this Association "could adopt a resolution requesting that all roads owning cars with end doors would make provision thereon that they could be sealed on the outside, so that a proper record could be obtained to enable the freight-claim agents in handling claims to properly locate the liabilty therefor."

In conclusion, the committee would refer to the danger to life and property incurred in the handling of private line cars equipped with hinged doors swinging outward. In the opinion of the committee such doors are much more dangerous to passing trains than any other type of freight-car door extant. Such doors are inherently dangerous, from the fact that if unlatched they will gravitate to open position on the slightest oscillation of the car. Again, in many cases, they swell to such an extent as to prevent them from closing properly. The fastenings are also continually getting out of order.

The committee is in hopes that the Association may take some action that will prompt the private line people to the adoption of some safer form of door.

Handholds and Height of Drawbars.

This report is simply a more complete presentation of the practices recommended by the committee as desirable and conforming to law, which was outlined in a statement furnished by them and issued by the association in August last. That statement, together with the diagrams accompanying it, can be found in our issue of September, 1895.—[Editor.]

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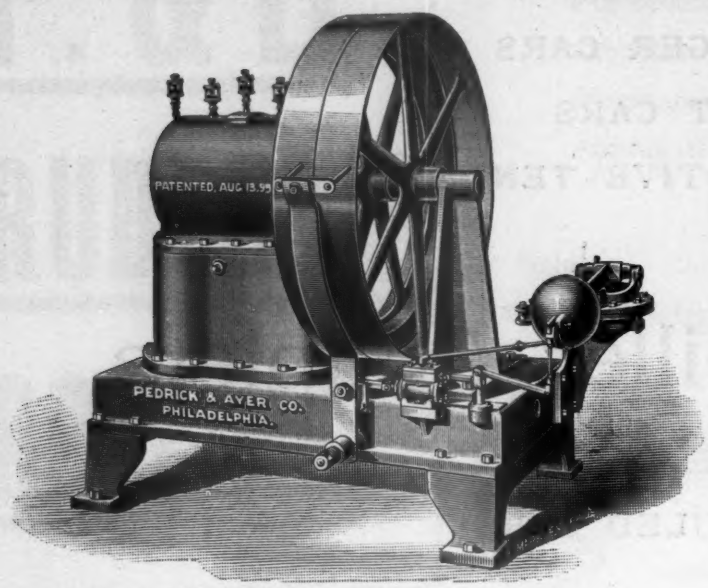

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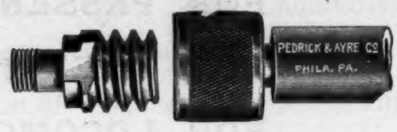

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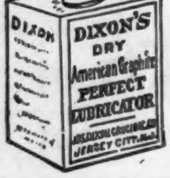

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